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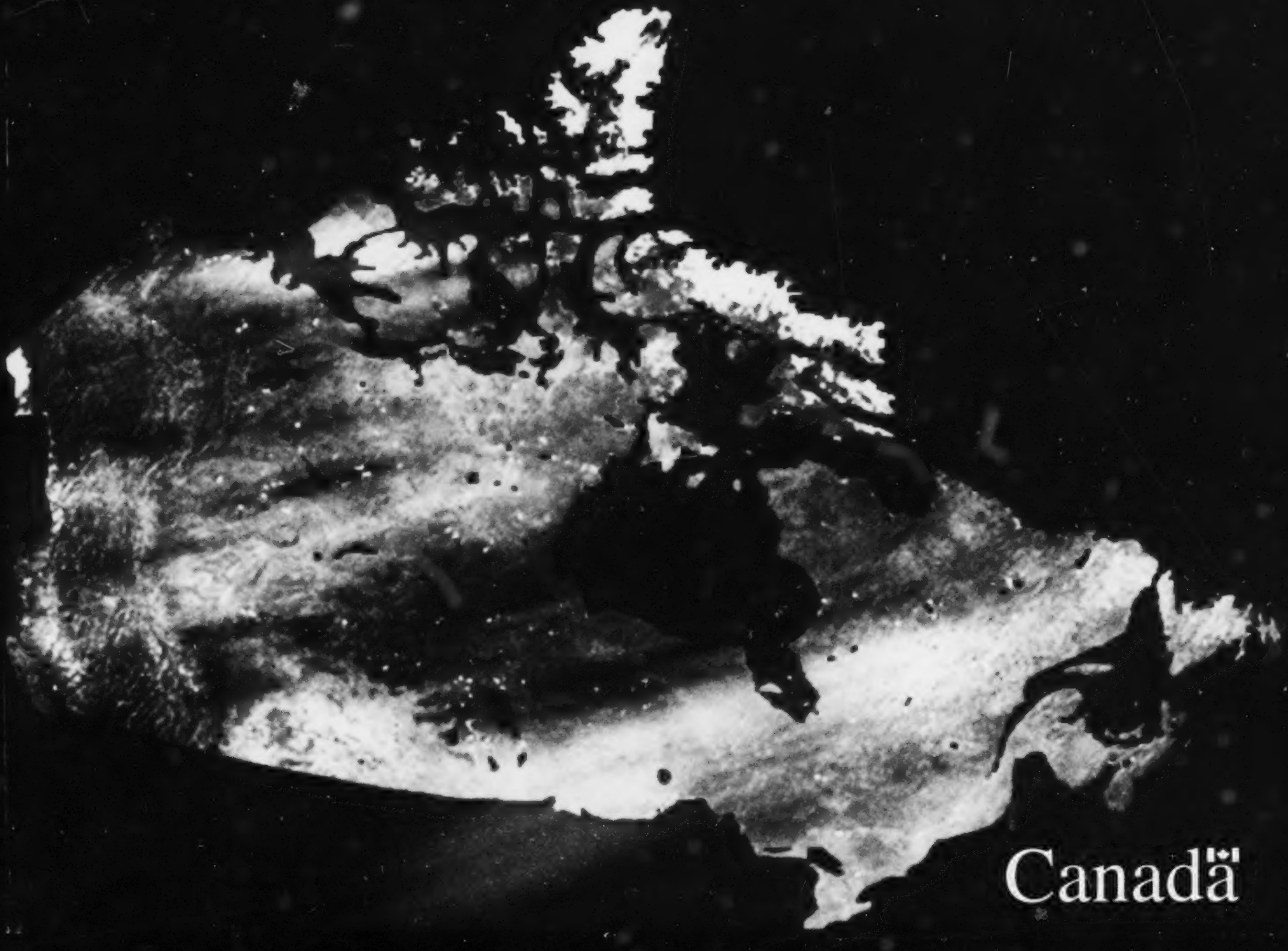
Canadian Minerals Yearbook

2001 REVIEW AND OUTLOOK



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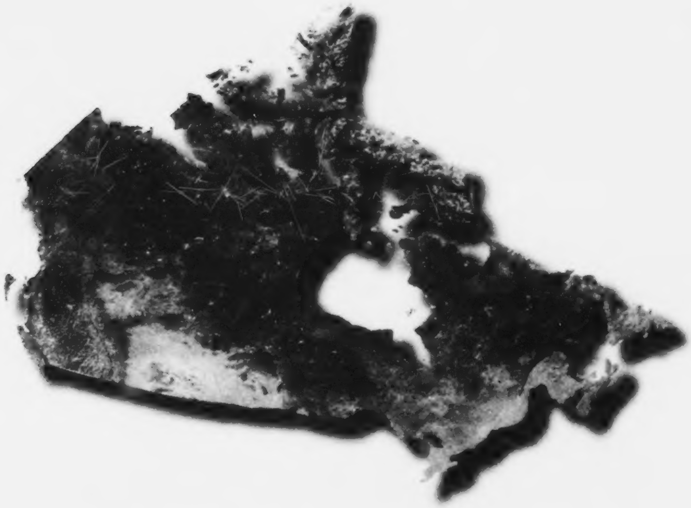

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Preface

Each year, the Minerals and Metals Sector of Natural Resources Canada undertakes a comprehensive review of developments in the mineral industry and publishes the results as the *Canadian Minerals Yearbook*. This publication forms a continuing record from year to year, with this edition reporting on the activities of the industry during 2001 (some events in 2002 may be referenced).

The main focus of this publication is the non-fuel mineral industry, together with uranium and coal, although all mineral fuels are normally included when the total value of Canada's mineral production is reported. The Yearbook includes chapters devoted to each major mineral commodity produced in Canada. The subject matter spans all stages of mineral industry activity from geoscience and exploration, through mining and processing, to markets and use. Although domestic issues receive the greatest attention in each chapter, international developments may also be reviewed because of the global nature of the mineral industry and the significant impact that such developments could have on the Canadian industry.

The Yearbook's first chapter, entitled "General Review," highlights the importance of the industry in the context of the Canadian economy. In 2001, the non-fuel mineral industry accounted for approximately 2.6% of total national employment, 3.7% of Canada's Gross Domestic Product, and 12.7% of Canada's total domestic exports. The General Review is followed by chapters that focus on the Canadian scene with reviews on mine reserves and recent production decisions; mineral exploration and discoveries; and mine openings and closings. Chapters that detail Canada's global mining presence abroad and outline developments on the international scene are also included, as well as a new chapter this year entitled "Canada's Historical Mineral Production."

The 26 commodity reviews in this year's edition feature economic and policy developments and data specific to each commodity in respect of markets, prices, production, trade and use. These commodity chapters also provide an outlook on the industry's future position.

The Statistical Report at the end of the Yearbook is a comprehensive set of tables that provide a detailed statistical overview of the mineral industry. These tables are grouped according to the following topics: production; trade; use; prices; principal statistics; employment, salaries and wages; mining and exploration; transportation; and investment and finance. Although the tables focus on the most recent data available, many of the tables also include historical statistics.

The basic statistics on Canada's mineral and metal production, trade and use were collected by the Minerals and Mining Statistics Division of Natural Resources Canada, or by Statistics Canada, unless otherwise noted. Market quotations were taken mainly from published marketing reports. Corporate data presented in the various chapters of this Yearbook were obtained by the authors directly from company officials through surveys or correspondence, or were taken from web sites and annual reports. Natural Resources Canada is grateful to everyone who has contributed information used in the preparation of this publication.

Additional copies of the 2001 Yearbook may be purchased from the Geological Survey of Canada Bookstore (telephone (613) 995-4342 or 1-888-252-4301 [toll free], or e-mail gscbookstore@nrcan.gc.ca) and local booksellers. Previous editions of the *Canadian Minerals Yearbook* have been deposited in various libraries across Canada.

For more information on the products and services available from the Minerals and Metals Sector, visit our web site at www.nrcan.gc.ca/mms/index.htm, or contact us at:

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Note: Previous and current commodity reviews prepared by the Minerals and Metals Sector since 1994 are also available on our web site at:

www.nrcan.gc.ca/mms/cmy/com_e.html

Updates will be posted as they become available.

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Table of Contents

1. **General Review**
2. **Canadian Reserves of Selected Major Metals, and Recent Production Decisions**
3. **Mineral Exploration, Deposit Appraisal and Mine Complex Development Activity in Canada**
4. **Canadian Mineral Exploration and Discovery Analysis**
5. **Canadian Mine Openings, Closings, Expansions, Extensions and New Mine Developments**
6. **International Scene**
7. **Canada's Global Mining Presence**
8. **Canada's Historical Mineral Production**
9. **Aluminum**
10. **Antimony**
11. Barite (1997)
12. **Bismuth**
13. **Cadmium**
14. **Calcium Metal**
15. **Cement**
16. Cesium (1995)
17. Chromium (1995)
18. Chrysotile (1999)
19. Clays (1992)
20. **Coal**
21. Cobalt* (1996)
22. **Copper**
23. **Diamonds**
24. **Gold**
25. Graphite (1994)
26. **Gypsum and Anhydrite**
27. **Indium**
28. **Iron Ore**
29. **Lead**
30. **Lime**
31. Lithium (1995)
32. **Magnesium**
33. Manganese (1994)
34. **Mercury**
35. **Mineral Aggregates**
36. Molybdenum (1996)
37. Nepheline Syenite (1992)
38. **Nickel***
39. Niobium (1994)
40. Peat (1995)
41. Platinum Group Metals (1996)
42. Potash (2000)
43. Recyclable Metals (1994)
44. **Salt**
45. Selenium and Tellurium (1995)
46. **Silica**
47. Silicon (1995)
48. Silver (1997)
49. Sodium Sulphate (1992)
50. **Stone**
51. Strontium (1995)
52. Sulphur (2000)
53. Talc, Steatite and Pyrophyllite (1992)
54. Tantalum (1994)
55. Tin (1997)
56. Titanium (1995)
57. Tungsten (1994)
58. **Uranium**
59. **Vanadium**
60. Wollastonite (1992)
61. **Zinc**
62. Canada's Rank in World Mining (2000)
63. **Statistical Report**
64. **Definitions and Valuation: Mineral Production, Shipments and Trade**

* The 2001 nickel review contains some textual information and statistical tables on cobalt.

Note: Commodities shown in **bold** type are covered in this issue. The other commodities listed have appeared in previous editions for which the most recent year is indicated in parentheses.

Canadian Minerals Yearbook

2001 Review and Outlook

NOTE TO READERS

The intent of this publication is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The authors and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this publication.

ABBREVIATIONS

The reader should note that a number of abbreviations for common units of measurement appear in the text:

cm	centimetres
ct	carats
ct/t	carats per tonne
ct/y	carats per year
ft	feet
ft^2	square feet
g	grams
GJ/t	gigajoules per tonne
g/t	grams per tonne
h	hour
ha	hectares
kg	kilograms
kgU	kilograms of uranium
km	kilometres
km^2	square kilometres
kWh	kilowatt hours
L	litres
lb	pounds
m	metres
m^2	square metres
m^3	cubic metres
Mct	million carats
mg	milligrams
mg/d	milligrams per day
mm	millimetres
Mt	million tonnes or megatonnes
Mt/y	million tonnes per year
MW	megawatts
oz	ounces or troy ounce
ppm	parts per million
st	short tons
t	tonnes
t/d	tonnes per day
t/h	tonnes per hour
t/y	tonnes per year
tU	tonnes of uranium
µg	micrograms
y	year

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General Review

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OVERVIEW

Global economic demand slowed considerably in 2001, notably in the United States, resulting in a build-up of inventories and a decline in manufacturing activity. Business investment was weak and the strong consumer spending that had driven many of the world's economies over the past several years began to soften during the year. The results were felt by the mineral industry where depressed demand for most mineral commodities sent prices tumbling in 2001, particularly for the major metals.

Canada's real Gross Domestic Product (GDP), measured at market value in 1997 prices, increased by 1.5% in 2001 to $1024.2 billion, compared to growth of 4.5% in 2000. Both interest rates and inflation remained low in 2001 aided by nine Bank of Canada interest rate cuts. The average annual unemployment rate rose to 7.2% from 6.8% in 2000 and the value of the Canadian dollar in terms of the United States dollar averaged $0.646, down from $0.673 for 2000. Total Canadian exports (Customs basis) decreased to $402.3 billion, down 2.6% from $412.9 billion in 2000, but still significantly higher than the $355.1 billion recorded in 1999. Imports (Customs basis) totaled $343.0 billion, compared to $356.9 billion in 2000 and $320.4 billion in 1999.

Preliminary estimates for the value of production[1] for all sectors of the Canadian mining and fuel extraction industry reached $83.8 billion in 2001, nearly matching the record high of $83.9 billion in 2000. This strong showing was due to continuing strong performance in the fuels sector, particularly by natural gas. When fuels are excluded, the value of production for the mining industry (Canadian-based mines) declined by 3.4% to $17.8 billion. Metal production decreased by 6.8% to $10.2 billion while nonmetal production, including structural materials, increased by 1.7% to $7.6 billion.

The value of total exports for non-fuel mining and mineral processing products (including coal) fell to $48.7 billion, a 4.2% decline from $50.8 billion in 2000. The 2001 export figure represented 12.1% of Canada's total exports. Canadian imports of non-fuel mining and mineral processing products (including coal) declined to $46.6 billion, a 9.0% drop from $51.2 billion in 2000. As a result, the balance of trade (total exports minus imports) showed a surplus of $2.1 billion in 2001, replacing the small deficit that had occurred in the previous year.

Prices of most of the major metal commodities fell during the year from highs reached at the beginning of 2001. Of the major nonferrous metals, only lead and uranium prices were slightly higher at year-end as prices for nickel, copper, zinc and aluminum were all down from a year earlier. For precious metals, gold was up slightly for the year and silver was down narrowly, whereas palladium and platinum prices fell sharply during the year.

Corporate operating profits in the Canadian mining industry (excluding coal) were $2.3 billion in 2001, down 25.4% from $3.1 billion in 2000.

Significant developments affecting the Canadian non-fuel mineral industry in 2001 included:

- a deteriorating financial performance by Canadian mineral and metal producers due in large part to weakening global economic conditions and low commodity prices;
- generally sluggish activity in mineral exploration and mine development, although strong exploration and development activity in Canada's diamond industry continued;

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[1] Throughout this article, the volume and value of production data are based on estimates using shipments as the measure of mine production, as published in Canada's Mineral Production, Preliminary Estimates, Statistics Canada, cat. no. 26-202-X1B.

- more mine closings than openings, including the closing of the long-operating Sullivan mine in British Columbia; and
- decreased employment in mining.

The outlook for the Canadian mineral industry in 2002 is hopeful. In late 2001, there were signs of improving economic demand conditions and of an end to metals inventory reductions on a global basis. As well, cutbacks in mine production and processing capacity that had taken place, or are scheduled in 2002, will have a positive effect on overall supply/demand market dynamics. These factors should lead to higher prices and better health for the global mineral industry, including Canadian companies.

THE CANADIAN ECONOMY

Growth in the Canadian economy slowed noticeably in 2001 as GDP grew by only 1.5%, down from 4.5% in 2000 and 5.1% in 1999. Indeed, there was negative growth in the third quarter of the year, compared to the second quarter, a reflection, to some degree, of the negative repercussions on economic activity resulting from the September 11 terrorist attacks in the United States. This was particularly noticeable in the transportation, hospitality and tourism sectors.

In response to the economic slowdown that was evident early in the year, the Bank of Canada lowered its bank rate nine times during the year. From a rate of 5.75% at the beginning of the year, decreases ranging from 25 to 75 basis points were made between late January and late November, resulting in an end-of-year rate of 2.50%. The annual inflation rate (Consumer Price Index) remained within the Bank of Canada's annual target range of 1-3%, averaging 2.6% in 2001, down from 2.7% in 2000. In 1999 the rate was 1.7%. The value of the Canadian dollar in terms of the U.S. dollar averaged $0.646, down from $0.673 for 2000. This represents a 4.1% decline and continues the trend of the 1990s when the dollar lost nearly one third of its value. The average annual unemployment rate rose to 7.2% from 6.8% in 2000.

Even with the slowdown in economic activity in 2001, consumer spending was robust. Canada Mortgage and Housing Corporation announced that new housing starts increased by 7.3% to 162 733 units in 2001 as home buyers took advantage of significantly lower mortgage interest rates. Similarly, the Canadian Real Estate Association reported that existing house sales across Canada on the Multiple Listing Service increased by 14% from 333 822 in 2000 to 380 458 in 2001, an all-time high. (The previous high was 335 490 in 1999.)

Statistics Canada announced that new motor vehicles sales rose to a record 1.6 million units in 2001, an increase of 0.6% over 2000. This was due in part to strong sales in the fourth quarter as companies offered strong buying incentives, including zero interest financing, to maintain sales levels following September 11th. Of this total, passenger car sales rose 2.4% to 869 000. On the production side, automotive manufacturers in Canada produced 2.4 million vehicles in 2001 (1.3 million passenger cars and 1.1 million vans and trucks), down 11.0% from 2000.

CANADIAN ECONOMIC CONDITIONS

Leading Indicators	2000	2001	% Change
Real GDP ($ billions, 1997 prices)	929.6	940.0	1.1
Consumer prices (% annual change)	2.7	2.6	n.a.
Operating profits ($ millions)	197.7	156.8	-20.7
Unemployment rate (% annual average)	6.8	7.2	7.3
Merchandise trade balance (balance of payments basis) ($ billions)	59.3	62.6	n.a.
Housing starts (000)	151.7	162.7	7.3
U.S. exchange rate (annual average)	0.6733	0.6458	-4.08
International current account balance ($ millions)	26 894	29 100	n.a.
Global economic output (% change)	+4.7	+2.5	n.a.

Sources: Statistics Canada; Canada Mortgage and Housing Corporation; Bank of Canada; International Monetary Fund.
n.a. Not applicable.

Based on annual averages, employment in Canada rose by 167 100, or 1.1%, in 2001, down from 378 500 in 2000, a 2.6% growth rate over 1999. The average unemployment rate for 2001 was 7.2% although, in the last quarter of 2001, the rate reached 7.7%.

On the trade front, total Canadian merchandise exports fell to $402.3 billion from $412.9 billion in 2000, a decline of 2.6%. However, the trade surplus (total exports minus imports) rose to $59.3 billion, an increase of 5.9% over the $56.0 billion trade surplus experienced in 2000. Imports totaled $343.0 billion in 2001 compared to $356.9 billion in 2000.

Global economic activity (as measured by GDP) increased in 2001 by 2.5%, down sharply from 4.7% in 2000 and 3.6% in 1999. The U.S. economy fell from 4.1% in 2000 to 1.2% in 2001. Western Europe declined from a 3.3% growth rate in 2000 to 1.6% in 2001, with Germany falling from 3.2% to 0.7% and the United Kingdom falling from 3.0% to 2.4%. Japan fell from a 2.2% growth rate in 2000 to -0.4% in 2001. China declined only slightly from 8.0% in 2000 to 7.3% in 2001. Growth in South America declined to 1.3% from 4.3% in 2000.

THE CANADIAN MINERAL INDUSTRY

The Canadian mineral industry can be characterized by the following four stages of processing activity:

- Stage 1: Mineral extraction and concentrating industry (for example, gold mining, quarries and sand pits);
- Stage 2: Smelting and refining industry (for example, nonferrous smelting and refining, alloying, and the production of primary steel);
- Stage 3: Nonmetals and metals-based semi-fabricating industries (for example, copper rolling, casting and extruding, and concrete products); and
- Stage 4: Metals fabricating industries (for example, manufacturing of ornamental metal products and machine parts).

While much of the emphasis of this article focuses on Stage 1 activities (the activities of the mining industry), a description of the mineral industry as a whole (Stages 1 to 4) provides a more comprehensive picture of its importance to Canada. In the context of this article, the mineral industry should be taken to exclude the extraction and processing of crude petroleum and natural gas, but to include both the coal and uranium mining industries.

CANADIAN MINERAL INDUSTRY

Leading Mining Indicators	2000	2001	% Change
Value of non-fuel mineral production ($ millions)	19 842	19 345	-2.51
Exploration expenditures ($ millions)	496.7	491.3	-1.1
Metal Price Index (1997=100)			
Precious metals	87.9	83.3	
Base metals	94.4	73.8	
Direct mining employment (000)	51.4	46.4	-9.8
Value of minerals and mineral products domestic exports ($ billions)	49.5	47.4	-4.3
Mining company operating profits ($ billions)	3.1	2.3	-25.5
Mine financing ($ billions) (Gamah International, April 2002)	6.2	5.1	-18.1

Sources: Natural Resources Canada; Statistics Canada; Gamah International.
Note: All the indicators above, with the exception of the Metal Price Index and mining company operating profits, include the coal mining industry.

GDP OF THE MINERAL INDUSTRY

In 2001, the mineral industry, as defined above, contributed $35.1 billion, or 3.7% of Canada's total GDP of $940.0 billion, a decrease of 0.8% from 2000.[2] Mining (mineral extraction and concentrating – Stage 1) contributed 25.0% of the industry's GDP in 2001 while smelting and refining (Stage 2) added a further 21.1% to the total. Nonmetals and metals-based semi-fabricating (Stage 3) accounted for 22.3% and metals fabricating (Stage 4) accounted for the remainder at 31.6%.

For mining (or Stage 1) in 2001, GDP increased by 0.8% to $8.8 billion as coal mining increased by 3.6% to $1.1 billion and metal mining increased by 1.0% to $5.0 billion, while nonmetals, including structural materials, declined by 0.5% to $2.7 billion. GDP for support activities related to mining and oil and gas (not included in the stage totals given) rose by an estimated 5.5% to $5.3 billion in 2001.

Because these figures are based on 1997 prices, an increase in the value of GDP indicates an increase in the volume of goods and services produced. These proportions can be misleading, however, in that they are based on 1997 prices and thus may not reflect commodity prices as they were in 2001.

CANADIAN MINERAL PRODUCTION

Production from Canadian Mines, Quarries and Oil/Gas Wells

Based on preliminary estimates and using shipments as the measure of mine production, the total value of Canadian mineral production (including fuels) amounted to $83.8 billion, just fractionally off the record high of $83.9 billion set in 2000. The continuing high level of the value of mineral production was due to another strong performance by the fuels sector, up 0.8% to $66.0 billion. Non-fuels (metals and nonmetals) declined in value by 3.4% to $17.8 billion, with a sharp fall in metals value more than offsetting a modest increase in the value of nonmetals.

The value of metals production fell by 6.8% to $10.2 billion in 2001 from $11.0 billion in 2000 as significant decreases occurred in the values for nickel, copper, zinc, iron ore and cobalt. Gold was the only

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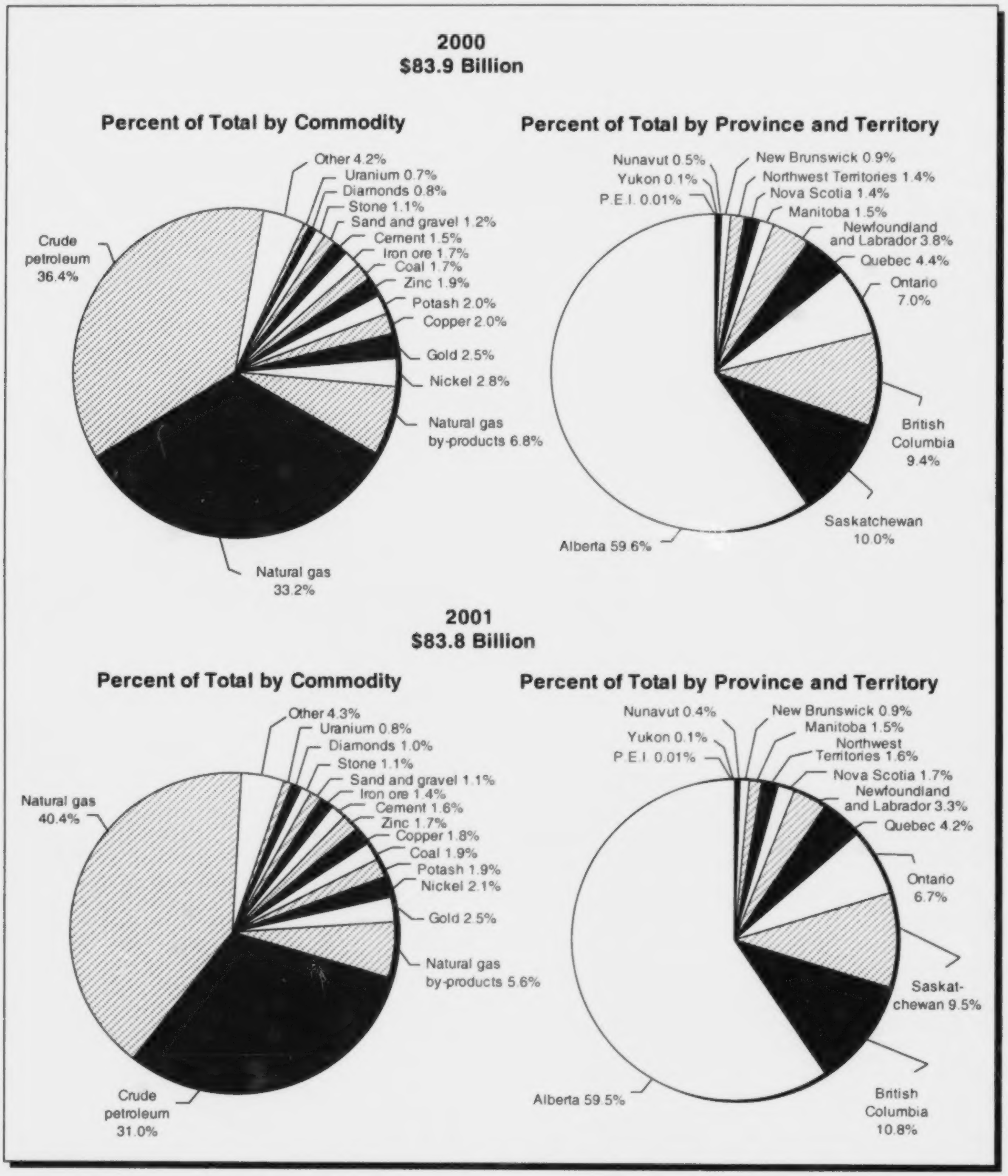
[2] In this section, all figures are based on GDP at basic prices and at 1997 prices.

Figure 1
Value of Mineral Production, Percent Shares by Commodity and by Province and Territory, 2000 and 2001



2000
$83.9 Billion

Percent of Total by Commodity

Percent of Total by Province and Territory

2001
$83.8 Billion

Percent of Total by Commodity

Percent of Total by Province and Territory

Sources: Natural Resources Canada; Statistics Canada.
Note: The provincial/territorial shares may not add to 100% due to rounding.

metal produced in Canada that had a value of production over $2 billion in 2001. It was Canada's leading metal with a value of $2.1 billion, an increase of 2.9% and a reflection of an increase in gold output of 2.2%.

Nickel production rose by 1.4%. However, substantially lower prices led to a fall in its value of 24.1% to $1.8 billion. Copper production was only 1.7% lower in 2001, but lower prices resulted in a value drop of 9.7% to $1.5 billion. The value of zinc production was off by 9.6% to $1.4 billion, again due to much lower prices as output was ahead by 7.9%. Iron ore production fell by 23.5%, reflecting lower steel demand in North America. As a result, the value of iron ore production fell 18.9% to $1.2 billion. Lower prices for cobalt led to a fall of 22.1% in the total production value of $78.2 million, even though production volumes were up by 1.3%.

VALUE OF CANADIAN MINERAL PRODUCTION[1]

	2000 (r)	2001 (p)	Change
	($ millions)		(%)
Metallic minerals	10 988.9	10 245.4	-6.8
Nonmetallic minerals	7 425.7	7 552.3	1.7
Total non-fuels	18 414.7	17 797.7	-3.4
Fuels	65 439.3	65 984.7	0.8
Total minerals	83 854.0	83 782.4	-0.1

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, 2001, cat. no. 26-202-XIB.
(p) Preliminary; (r) Revised.
(1) The value of non-fuels production is based on shipments.
Note: Numbers may not add to totals due to rounding.

Among the value of other metals, shipments of uranium increased by 42.8% to $675.6 million (production up by 31.0%), platinum group metals were up by 18.9% to $568.8 million (production up by 18.6%), and silver declined by 4.0% to $267.9 million (production up by 4.7%). The value of lead increased by 12.2% to $108.3 million (production up by 4.3%) and molybdenum rose by 22.8% to $77.1 million (production up by 22.3%). Mine production of uranium was up almost 25% to about $600 million.

The value of nonmetal production (including structural materials) rose to $7.6 billion in 2001, an increase of 1.7% over 2000. Increases in the value of cement, diamonds, salt and clay products more than offset declines in many of the other leading nonmetals, such as potash, sand and gravel, and lime. Potash decreased in value by 3.8% to $1.6 billion with a production fall of 9.4%. Nevertheless, potash remained the leading nonmetal produced in Canada and was the only one with a production value greater than $1.5 billion in 2001.

The value of cement rose to $1.3 billion, an increase of 4.3%, as production was up by 3.0%, while the value of sand and gravel declined by 1.9% to $953.2 million (production down by 5.4%). The value of diamond production was up by 35.5% to $846.9 million as the total number of carats produced increased by 51.3%. The value of salt shipments increased by 27.9% to $449.5 million as production volumes were up by 11.4%.

Among the other nonmetals, the value of lime fell by 10.6% to $212.4 million (production fell by 12.0%), clay products rose by 11.3% to $195.2 million, asbestos fell by 6.7% to $132.2 million (production down by 5.2%), and gypsum fell by 8.7% to $96.4 million (production down by 5.3%).

The value of production for mineral fuels rose by just 0.8% in 2001 to $66.0 billion, an all-time record high. An increase of 21.5% in the value of natural gas to $33.8 billion (production up by 2.5%) and an increase of 8.4% in coal value to $1.5 billion (production up by 1.7%) fractionally offset the declines of crude oil and natural gas by-products. The value of crude oil production fell by 15.0% to $25.9 billion (although there was an increase in production of 2.1%) and natural gas by-products fell by 17.3% to $4.7 billion (a decline in production of 2.5%).

Based on the value of production for 2001, the top non-fuel commodities were gold ($2.1 billion), nickel ($1.8 billion), potash ($1.6 billion), copper ($1.5 billion), zinc ($1.4 billion), cement ($1.3 billion), iron ore ($1.2 billion), and sand and gravel ($953.2 million). In terms of the levels of production of Canada's leading minerals, increases in output of 5% or greater were recorded for diamonds, uranium, molybdenum, platinum group metals, salt and zinc, whereas declines of 5% or more were experienced by iron ore, lime, peat, sand and gravel, gypsum, and asbestos.

The industry may be more important on a regional and community basis as, in many parts of Canada, particularly in the North, it provides a major economic stimulus. Over 100 communities were heavily reliant on the mineral industry in 2000 and approximately 600 000 Canadians lived in these communities.

Regionally, four provinces continued to dominate the value of Canada's non-fuel mineral output in 2001, accounting for 74.3% of the total. Ontario contributed the largest share of the non-fuel mineral output with 30.9% of the total value while Quebec contributed 19.6%, Saskatchewan contributed 12.9% and British Columbia contributed 10.8%. Among the remaining provinces and territories, the Northwest Territories and Manitoba each accounted for 5.1%, Newfoundland and Labrador for 4.7%, New Brunswick for 4.3%, Alberta for 3.1%, Nunavut for 1.8%, Nova Scotia for 1.3%, and the Yukon for 0.2%. The value for Ontario decreased by 3.6% to $5.5 billion, Quebec was down by 4.4% to $3.5 billion, Saskatchewan was up by 7.2% to $2.3 billion, and British Columbia was down by 7.3% to $1.9 billion. When coal is included, the value of Saskatchewan's production rises to $2.4 billion, up by 7.2% from 2000, and the value of British Columbia's production increases to $2.9 billion, a decrease of 0.7% compared to 2000.

Alberta is Canada's major fuels producer with a value of production of $49.3 billion, or 74.7% of Canada's total in 2001. Alberta produces a full complement of mineral fuels: crude petroleum, natural gas, natural gas by-products and coal. Other provinces with significant mineral fuel production are British Columbia with 10.8% and Saskatchewan with 8.6%, respectively, of Canada's total. Newfoundland and Labrador, growing in relative importance, accounted for 3.0% and the other provinces and territories accounted for the remaining 3.0%.

There were only 2 mine openings in 2001, while 14 mines closed (8 were suspensions and 6 were permanent closures). One opening was in Newfoundland and Labrador and the other was in British Columbia. Three of the closures were in Quebec, three were in British Columbia, and two were in Ontario. There was one each in Newfoundland and Labrador, Nova Scotia, New Brunswick, Manitoba, Saskatchewan, and the Yukon. One of the permanent closures was Teck Cominco Limited's Sullivan mine. This mine, located in Kimberley, British Columbia, closed in late 2001 due to ore depletion 92 years after going into commercial production in 1909. The mine was founded on an orebody discovered in 1892 and became one of the world's largest lead-zinc-silver mines and Canada's longest- running mining operation.

Mineral and Metal Production from Recycled and Imported Materials

Annual statistical series of Canada's mineral production have to date only included the production and value of minerals and metals obtained from Canadian-mined ores and concentrates. Statistics on the production and value of recycled materials or minerals and metals produced from imported ores, concentrates, and recycled minerals and metals have not been generally available, despite the fact that Canada is a major producer of metals, most notably aluminum, from imported ores. Work has started on the development of new statistical series to present information that will characterize the production of these materials in Canada.

MINERAL AND METAL COMMODITY PRICES

The weakness in mineral and metal commodity prices that was evident in the latter stages of 2000 continued into 2001 as global economic conditions worsened sharply in almost all countries with the notable exception of China. Indeed, GDP for the world economy is estimated to have increased by only 2.5% in 2001, down from 4.7% in 2000.

Prices for most major metals, including nickel, copper, aluminum and zinc, finished 2001 at levels lower than they started the year. Only lead and uranium ended 2001 with higher price levels than at the beginning. Across the world, these lower commodity prices led to mine closures. However, even with lower prices, many higher-cost producers continued to operate due in large part to local currencies that were relatively weak compared to the U.S. dollar.

Based on trading on the London Metal Exchange (daily closings), nickel opened 2001 at US$3.17/lb with inventories at 9624 t and finished the year at US$2.58/lb with inventories at 18 966 t. Nickel hit its high for the year in mid-May at US$3.42/lb and its low at US$2.00/lb at the end of October. Prices reacted in response to weak demand in major end-use nickel markets throughout much of the year. This was particularly true for stainless steel, the largest market for nickel. Stocks reached a low of 8304 t in mid-March and peaked at 19 002 t in mid-November. Copper opened the year at US80.9¢/lb, increased to US83.3¢/lb later in January, and then declined throughout the year to a low of US59.8¢/lb in early November before recovering to 66.3¢/lb at year-end. Copper use fell during the year, in large part due to reduced demand in the automotive sector. Cutbacks in production were not sufficient to prevent erosion in price levels. Copper stocks began the year at 358 625 t, fell to a low of 322 775 t in early March, and then climbed to reach their high at the end of 2001 of 798 675 t.

Aluminum began the year at US71.1¢/lb, increased to US78.8¢/lb in late January, declined to a low of US56.4¢/lb in early November, and finished the year at US60.6¢/lb. The use of aluminum fell, notably in the United States and, notwithstanding global production cutbacks, prices weakened. Indeed, inventories increased steadily from 326 825 t at the beginning of the year to 819 175 t at its end.

Zinc began 2001 at US46.2¢/lb, moved up to US47.8¢/lb in mid-January, and then steadily declined to a low of US33.3¢/lb in early November before recovering slightly to US34.8¢/lb to close out the year. Weakened demand and new capacity coming on stream combined to create a large zinc supply surplus, resulting in downward pressures on prices. Stocks began the year at 194 700 t and closed out the year at more than double that at 433 375 t. The price of lead actually increased in 2001, ending the year at US22.9¢/lb, compared to US21.2¢/lb at the beginning of the year. It reached a high of US23.7¢/lb in mid-March and a low of US19.6¢/lb in early July. Lead-acid battery demand weakened in 2001, but limited availability of concentrate had a positive impact on prices, particularly late in the year. Inventories began the year at 131 150 t, increased to 143 930 t in early March, reached a low of 87 000 t in mid-December, and finished the year at 97 050 t.

Gold closed out the year at US$276.50/oz, up fractionally from US$271.10/oz at the beginning of 2001. The low for the year (US$255.95/oz) occurred in early April and the high (US$293.25/oz) in September following the terrorist attacks in the United States on September 11th. Globally, demand was down slightly and this lower demand, combined with a record gold production level in 2001, continued to have a negative effect on the price. Silver prices began the year at US$4.59/oz, hit a high of US$4.81/oz in late January, and then declined for most of the year to reach a low of US$4.07/oz in mid-November. At that point, the price of silver rebounded, finishing at US$4.50/oz, largely unchanged from the level at which it started the year. The supply of silver increased as China unloaded its silver reserves.

Palladium prices, which were bid up to extraordinary levels in 2000 and early 2001, returned to more normal levels in 2001. Palladium began the year at US$965.00/oz, reaching a peak price in mid-January of US$1090.00/oz, and then declined to a low of US$315.00/oz in late November and ended the year by recovering to US$440.00/oz. The resumption of Russian supplies entering the marketplace early in the year and the cessation of aggressive buying by one of North America's leading automotive producers were significant factors leading to this major price correction. Platinum prices, which tended to track those of palladium, also contracted in 2001, although not to the same degree as palladium, reverting to the historical pattern of platinum being more valuable than palladium. Platinum started the year at US$608.00/oz, topped out at US$639.50/oz in mid-January, declined to US$415.00/oz in early October, and finished the year at US$480.00/oz.

The spot price for uranium (U_3O_8) was quoted at US$9.50/lb at the end of 2001, an increase of nearly 34% over the US$7.10/lb quoted 12 months earlier. During the same period, long-term contract prices for uranium increased from US$9.25/lb to US$10.50/lb, an increase of 13.5%. At year-end, cobalt was selling at about US$6.75/lb, down sharply from the selling price of about US$10.50/lb a year earlier. Potash was quoted at US$128.00/t for standard grade, f.o.b. Vancouver, roughly the same as a year earlier. The price for sulphur, f.o.b. Vancouver at the end of 2001 was US$15-$22/t, compared to US$30-$36/t at the end of 2000. This drop in prices was largely due to oversupply and strong competition in offshore markets.

International coal and iron ore prices are largely determined by annual Japanese reference or benchmark contract pricing. On this basis, coal prices for delivery into the Japanese market increased noticeably in 2001 as metallurgical coal (hard coking) increased by 7.5% to US$42.75/t f.o.b. and thermal coal (steaming coal) increased by 20.0% to US$34.50/t f.o.b., the latter due in part to strong oil prices. For iron ore, prices for concentrates bound for Europe and Japan increased by 4.55% and 4.29%, respectively, and by 1.84% for pellets bound for Europe (refer to Table 5 in the Iron Ore chapter).

RESERVES

In 2000, Canadian reserves of copper, nickel, lead, zinc, molybdenum, silver and gold decreased. No decisions had been made to bring new mines into production for these metals, and the amount of new ore discovered at existing mining operations was insufficient to replace the quantity of ore mined during the year. This continued the ongoing trend of declining ore reserves that had begun in the early 1980s for base metals and in the late 1980s for gold. Improved prices for copper, nickel and zinc were overwhelmed by deteriorating prices for lead, molybdenum and silver, together with the stagnant price of gold.

EMPLOYMENT IN THE MINERAL INDUSTRY

Combined employment in the four stages of the mineral industry (including coal mining) is estimated to have reached 375 784 in 2001, down 3.4% from the preliminary 2000 level of 388 911. The mineral industry thus accounted for approximately 2.6% of the national employment level of 15.1 million (including both full-time and part-time workers) in 2001.[3]

Employment in Stage 1 (metal, nonmetal [including quarries and sand pits] and coal mining) decreased by 9.8% to an estimated 46 423, down from 51 445 in 2000 as a significant number of mines closed permanently or suspended operations. Employment in metal mining decreased by 15.5% and in nonmetal mining by 5.0%. However, expanded coal mining activity led to a 3.2% increase in coal mine employment during 2001.

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[3] Effective this year, these statistics are based on the North American Industrial Classification System (NAICS), which replaces the Standard Industrial Classification (SIC) system. This new classification standard is used by the three partners in the North American Free Trade Agreement (NAFTA), i.e., the United States, Mexico and Canada.

Employment levels for Stages 2, 3 and 4 were all lower in 2001 compared to the previous year. Employment in Stage 2 decreased by 8.6% to 53 878. Employment increased in the smelting and refining of nonferrous metals and the production of aluminum, but declined in iron and steel. Stage 3 employment fell by 2.9% to 83 779, due in large part to the continued decline in iron foundry employment, which fell by 5.5%. Stage 4 employment in metallic mineral manufacturing decreased by 0.3% to 191 705 as primary metal manufacturing fell by 5.6%. The slowing down of North American economies was the main contributor to these employment decreases.

The level of employment in the sector that provides support for mining, quarries, and oil and gas wells is estimated to have increased by 16.2% to 50 284 in 2001, with the majority of those jobs servicing the oil and gas extraction industries. This sector provides drilling services, conducts exploration, and provides other services linked to mineral extraction. In 2001, the number employed in mining diamond drilling was estimated to be about 1300, roughly the same as in 2000. Because there are no establishment-based surveys undertaken at this time by either Natural Resources Canada or Statistics Canada for these support activities industries, these numbers should be viewed with caution.

MINERAL INDUSTRY TRADE

Canada is one of the world's largest exporters of minerals and metals. The export of these commodities and more refined mineral products has a significant impact on Canada's overall merchandise balance of trade, and hence on the national standard of living. In 2001, the value of domestic exports of minerals and mineral products, including fuels, increased fractionally by 0.5% to $100.3 billion from $99.8 billion in 2000 (Table 2). With respect to the four stages of production, increases in exports in Stages 1 and 2 were sufficient to overcome decreases in Stages 3 and 4.

The United States is the leading destination by far for Canada's minerals and mineral product exports (non-fuel, but including coal), receiving total exports valued at $36.2 billion in 2001, or 76.3% of total exports. The European Union followed with 9.7%, Japan with 3.6%, Mexico with 0.5%, and all other countries with 9.9%. The top 20 countries accounted for 97.2% of total domestic exports. Based on the four stages of production, the United States accounted for 33.6% of Stage 1 exports, 76.1% of Stage 2, 83.9% of Stage 3, and 91.6% of Stage 4.

The value of domestic exports of metallic minerals and mineral products (all four stages of production) decreased by 5.5% to $36.1 billion, compared to $38.2 billion in 2000. On a commodity basis, decreases in the value of exports occurred for zinc (-21.7%), gold (-11.9%), nickel (-11.4%), iron and steel (-6.3%), and copper (-2.9%). Increases were shown by uranium (+47.9%), platinum group metals (+2.8%) and aluminum (+2.6%). Two commodity groups (aluminum, and iron and steel) accounted for 51.4% of these exports in 2001. For Stage 1 metallic commodities only, domestic exports decreased by 6.0% to $3.7 billion in 2001. For individual metallic commodities in Stage 1, domestic exports declined for copper (-11.8%), zinc (-11.8%) and iron ore (-10.3%), while exports increased for molybdenum (+15.8%), platinum group metals (+14.3%) and aluminum (+3.3%). Three commodities, iron ore, copper and aluminum, represented 58.1% of all Stage 1 metallic exports in 2001.

The total value of domestic exports of nonmetallic minerals and mineral products (for all four stages) declined to $9.3 billion in 2001 from $9.5 billion in 2000, a decrease of 1.5%. Decreases were experienced by nitrogen (-11.1%) and potash and potassium compounds (-8.5%), while increases occurred for salt and sodium compounds (+30.0%), cement (+8.6%), and glass and glassware (+8.1%). Two commodity groupings, potash and potassium compounds, and glass and glassware, accounted for 37.5% of total nonmetallic domestic exports. For Stage 1 only, total domestic exports of nonmetallic commodities decreased by 1.0% to $1.8 billion from $1.9 billion in 2000. Exports that declined were sulphur and sulphur compounds (-37.5%) and asbestos (-15.1%). Exports increased for diamonds (+14.9%) and peat (+4.2%). Diamonds alone represented 40.9% of all Stage 1 nonmetallic domestic exports in 2001.

For mineral fuels, the total value of domestic exports increased by 5.3% to $54.9 billion, up from $52.1 billion in 2000. Natural gas exports increased by 24.5% to more than offset the 9.5% fall in petroleum exports. Domestic exports of coal and coke were up from $1.9 billion in 2000 to $2.0 billion in 2001, an increase of 6.0%. Of the total mineral fuels domestic exports (four stages), natural gas accounted for 46.7% and petroleum 45.5%. Stage 1 mineral fuels accounted for 79.4% of all domestic exports.

The value of total imports of minerals and mineral products, including fuels (four stages), decreased by 7.5% to $64.2 billion from $69.4 billion in 2000. Excluding fuels, but including coal, imports declined to $46.6 billion in 2001, down from $51.2 billion, a fall of 9.0%. Of this amount in 2001, shipments from the United States accounted for 69.0% of this total with the European Union at 8.8%, Mexico at 3.3%, Japan at 2.2%, and all other countries at 16.7%. The top 20 countries accounted for 93.0% of total imports. For the four stages of production, imports from the United States accounted for 63.4% of Stage 1 imports, 45.1% of Stage 2, 71.0% of Stage 3, and 72.3% of Stage 4.

The total value of metal imports decreased to $37.1 billion in 2001 from $41.7 billion in 2000, a decline of 11.0%. Decreases occurred for copper (-45.4%), gold (-15.4%), iron and steel (-12.1%), and aluminum (-2.8%). The latter two commodities, iron and steel, and aluminum, accounted for 53.7% of all metal imports in 2001. For nonmetals, import values were down by 1.2% to $8.2 billion from $8.3 billion in 2000. Commodities that declined in 2001 were phosphate and phosphate compounds (-17.9%) and graphite (-9.3%). Gains were experienced by salt and sodium compounds (+16.5%) and clays and clay products (+2.2%). Two commodities, glass and glassware products, and clay and clay products, accounted for 47.1% of total imports of nonmetals in 2001.

The balance of trade generated (total mining and mineral processing industry exports, including fuels, minus total mining imports, including fuels) increased by 18.9% in 2001 to $37.9 billion. This trade surplus compares to $31.8 billion in 2000 and $17.7 billion in 1999. For the total economy, the trade surplus rose to $59.3 billion in 2001 (+5.8%) from $56.0 billion in 2000 and $34.7 billion in 1999.

INVESTMENT BY THE MINERAL INDUSTRY

Information on exploration expenditures and capital spending provides a useful indication of market conditions and of the perspectives that management and investors in the Canadian mining industry hold on future market conditions in relation to present productive capacity. In 2001, based on year-end valuations, 208 mining companies were listed on the Toronto Stock Exchange with a market capitalization of $91 billion, compared to 245 mining companies with a market capitalization of $67 billion in 2000 and approximately 300 companies with capitalization of $80 billion in 1999. Also, at the end of 2001, the Canadian Venture Exchange included over 1200 junior mining and exploration companies.

Exploration Expenditures

Final exploration data for 2000 show that exploration and deposit appraisal expenditures amounted to $496.7 million, compared to $504.3 million in 1999, a decrease of 1.5%. Preliminary estimates for 2001 indicate a further decline to $491.3 million. Revised company spending intentions for 2002, however, rebounded to show a slight gain to $518.2 million.

In 2000, increases in exploration and deposit appraisal expenditures were experienced in New Brunswick, Ontario, Manitoba, Saskatchewan and Nunavut, with decreases in the other provinces and territories. Only Ontario had expenditures in excess of $100 million in 2000 with spending at $117.9 million, which accounted for 23.7% of total Canadian expenditures.

Mine complex development expenditures (including capital and repair expenditures) were $3.6 billion in 2000, up 21.9% from 1999, with Quebec at 32.2% and Ontario at 22.3% of the total leading the way. Preliminary figures for 2001 show a further increase of 6.0% to $3.8 billion with a sharp increase in the Northwest Territories for diamond mine expenditures. Company forecasts are estimated at $3.2 billion in 2002, a decrease of 17.7% from 2001, but still up from the $3.0 billion experienced in 1999.

The level of mineral exploration activity is closely linked to mineral commodity prices, so it is not unexpected that, when prices are depressed, exploration expenditures decline. When commodity prices show signs of strength, the mineral exploration industry can be expected to respond with increased activity.

Capital Investment

In 2000, capital expenditures for construction and materials and equipment in the mining and mineral processing industries increased by 13.7% to reach $7.3 billion. However, company spending intentions indicate that capital expenditures will fall to $5.9 billion in 2001 and $4.8 billion in 2002. This reflects the declining trend of new mine development in Canada. Of these totals, capital investment for the mineral extraction and concentrating industry (Stage 1) are estimated at $2.8 billion in 2001, down from $3.0 billion in 2000 but up from $2.5 billion in 1999. The estimate for 2002 is $2.3 billion. Capital investment in the smelting and refining industry (Stage 2) declined by 18.3% to $724.6 million in 2001 from $887.2 million in 2000. In 1999, capital expenditures were $851.5 million. In 2002, reports on company spending intentions indicate an estimated level of $655.5 million. For the nonmetals and metals-based semi-fabricating industries (Stage 3), capital investment fell sharply by 38.6% to $1.6 billion in 2001 from $2.6 billion in 2000 and $2.3 billion in 1999. Another significant decline to $1.2 billion is indicated for 2002. The metals fabricating industries (Stage 4) declined to $802.4 million in 2001 from $819.4 million in 2000 and $840.7 million in 1999. Company intentions show a further drop to $676.1 million in 2002.

In 2000, capital investment (construction, materials and equipment) in the total Canadian economy stood at $187.4 billion. Estimates indicate an increase to $195.9 billion in 2001 to be followed by a slight decline to $194.0 billion in 2002. In 2000, investments in the mineral industry (Stages 1-4) accounted for 3.9% of these total Canadian capital expenditures.

This is estimated to drop to 3.0% in 2001 and 2.5% in 2002. When repair expenditures on structures, machinery and equipment are included, expenditures in the mining and mineral processing industries totaled $11.6 billion in 2000, the latest year for which repair data are available. Of this total, $4.5 billion was in Stage 1. The total in 2000 for all four stages represented 5.0% of the total capital and repair expenditures within the Canadian economy.

HIGHLIGHTS IN THE CANADIAN MINING INDUSTRY

Corporate Developments

Corporate operating profits in the Canadian mining industry were $2.3 billion in 2001, compared to $3.1 billion in 2000, but were higher than the $1.4 billion recorded in 1999.

In March, North American Tungsten Corporation Ltd. announced that it would be re-opening its CanTung tungsten mine located in the Northwest Territories, near the Yukon border, north of Watson Lake, Yukon. Sandvik AB and Osram Sylvania Products Inc., leading producers and users of tungsten, will purchase all of the mine's concentrate output, estimated at some 900 000 t, over a three-year period. The mine, which last operated in 1986, and the MacTung deposit located some 160 km to the north are estimated to represent the Western World's largest high-grade proven tungsten reserves and to comprise some 15% of the world's proven tungsten resource base. The mine and mill are expected to be operating in early 2002.

In May, Cameco Corporation finalized arrangements to invest in the Bruce Power Limited Partnership (Bruce Power), which has leased the Bruce A and Bruce B power stations from Ontario Power Generation until 2018. The stations are located near Kincardine in southern Ontario. Cameco, the world's largest uranium supplier, will be the exclusive supplier of uranium fuel for the facilities and will purchase $43 million of finished fuel inventory for resale to the partnership as needed. Ownership of Bruce Power is made up of British Energy (85%) and Cameco (15%). The 85% equity of British Energy can be reduced to 79.8% if the two main unions representing employees take up their full equity interest in the partnership that is available to them: the Power Workers Union (up to 4.0%) and the Society of Energy Professionals (up to 1.2%).

In June, Sherritt Coal Partnership, a partnership of Sherritt International Corporation and a subsidiary of the Ontario Teachers Pension Fund Board, completed the acquisition of all the securities of the Luscar Coal Income Fund (LCIF). The LCIF is an open-ended trust that has invested in the securities of Luscar Coal Ltd. On September 14, 2001, Sherritt Coal Partnership announced the change of its name to Luscar Energy Partnership (LEP). Luscar produces approximately 38 Mt/y of coal from mines in western Canada.

In September, the Iron Ore Company of Canada (IOC) suspended reconditioning of its pellet plant in Sept-Îles, Quebec, due to deteriorating market conditions, particularly in North America and Europe, IOC's major markets. The $360 million project was scheduled to come on stream in mid-2002 at a production rate of 4.5 Mt/y. Earlier in the year, the offer by Rio Tinto plc to purchase the 18.9% of IOC owned by the Labrador Iron Ore Royalty Income Fund (LIORIF) was turned down. However, Rio Tinto did manage to purchase a 20% stake in LIORIF. Ownership of IOC is split among three companies: Rio Tinto (56.1%), Mitsubishi Corporation (25.0%) and LIORIF (18.9%).

In November, Noranda Inc. announced that it was going to close its Gaspé copper smelter, located at Murdochville, Quebec, for six months effective at the end of April 2002, citing weak market conditions. The custom smelter treats copper concentrates from around the world, as well as recycled copper materials.

In December, the Prince coal mine, located at Point Aconi, Nova Scotia on Cape Breton Island, was closed. The mine, owned and operated by the Cape Breton Development Corporation (Devco), a federal Crown corporation, was shut down following unsuccessful efforts to sell the operation. It was the last mine producing coal in the Sydney coalfield of Nova Scotia and its closure brought to an end a period of coal mining that began in the early 1700s. Subsequent to the cessation of coal mining at Prince, later in December, Devco sold its surface assets (coal pier, the railroad infrastructure and the coal preparation plant) to Emera Inc., the parent company of Nova Scotia Power Inc. Emera will use the purchased assets to transport imported coal to the nearby coal-fired power stations at Point Aconi and Lingan.

The Diavik diamond project made significant progress in 2001 with major construction activities under way, including construction of the mill, capable of processing 5000 t/d of kimberlite ore, and the water diversion dikes. These dikes will enable open-pit mining of the four kimberlite pipes offshore near East Island in Lac de Gras in the Northwest Territories. The $1.3 billion development, which will be Canada's second diamond mine, is scheduled to come on stream in April 2003. Current estimates of proven and probable reserves in the mine plan are 25.6 Mt of kimberlite at a grade of 4.0 ct/t having a value of US$63/ct. The project is owned 60% by Diavik Diamond Mines Inc., a wholly owned subsidiary of

Rio Tinto plc, and 40% by Aber Diamond Mines Ltd., a wholly owned subsidiary of Aber Diamond Corporation.

Canada's potential third diamond mine at Snap Lake, located some 110 km south of the Ekati diamond mine in the Northwest Territories, is now on schedule to start production in 2006, and not 2004 as had been earlier indicated. De Beers Canada Mining, the owner of the kimberlite dyke project, has decided that more time is required for the permitting process and to further evaluate the resource and the mining plan. A land and water use permit application was filed in early 2001 with the Mackenzie Valley Land and Water Board to develop a 3000-t/d underground diamond mine. The current estimated reserves by De Beers for Snap Lake are 22.8 Mt at 1.63 ct/t with a value of $US100/ct.

Consolidations continued to have an impact on the Canadian mineral industry in 2001 as significant mergers and takeovers occurred. In July, Teck Corporation and Cominco Ltd. merged to form Teck Cominco Limited. The new Teck Cominco will be a diversified mining and metals company with interests in mines producing gold, copper, zinc and metallurgical coal in North and South America and Australia, as well as zinc-refining complexes in British Columbia and Peru. It will be the fourth largest North American-based base-metal mining and refining company and the third largest in market capitalization. In October, the BHP Billiton Group completed its $687 million takeover of Dia Met Minerals Ltd., thus acquiring Dia Met's 29% ownership in the Ekati diamond mine in the Northwest Territories and upping its total ownership in the diamond mine to 80%. In December, Barrick Gold Corporation completed the merger with Homestake Mining Company, making the new company the second largest gold producer in the world in terms of production and first in terms of market capitalization. Operations are located primarily in North America, Australia and South America. The new Barrick is estimating production of 5.7 million oz in 2002 from a reserve base of 84.3 million oz.

Inco Limited and the Government of Newfoundland and Labrador resumed discussions on the development of the Voisey's Bay nickel-copper-cobalt orebody in June. However, by year-end, although discussions were still ongoing, there were no signs of agreement. One of the major issues is where the ore will be processed, with the position of the province being that the mining plan should include the smelting of ore from the mine within the province.

Other important events in 2001 included:

- Northgate Exploration Limited expanding its inferred resources to 442 Mt grading 0.4 g/t gold and 0.23% copper at its Kemess North project, 7 km north of its Kemess South gold-copper mine in western British Columbia;
- Goldcorp Inc. increasing gold reserves at its high-grade mine at Red Lake, Ontario, to 1.85 million tons grading 2.05 oz/ton (70.5 g/t);
- North American Palladium Ltd. opening its $220 million mine expansion at Lac des Îles, in northern Ontario, which will increase mill throughput to 15 000 t/d; and
- Agnico-Eagle Mines Limited opening its new Penna shaft, the deepest single-lift shaft in North America, at its recently expanded LaRonde mine near Rouyn-Noranda.

Industry and Government Initiatives

The Government of Canada, through Natural Resources Canada (NRCan), in full collaboration with the provincial and territorial governments and the mineral industry, undertakes activities to promote and support Canada's minerals and metals industry and mining-related equipment and services sectors. In 2001, these activities included:

- missions to Mexico (Minister-led), Korea and Japan;
- participation by NRCan in a number of trade shows and exhibitions, e.g.:
  - EXPOMIN-AMERICA 2001 - Santo Domingo, Dominican Republic,
  - Prospectors and Developers Association of Canada's International Convention, Trade Show and Investors Exchange - Toronto, Canada, and
  - Investing in the Americas Conference, Miami, United States;
- new projects under the Targeted Geoscience Initiative by the Geological Survey of Canada, including:
  - a geological study of diamond-bearing rock in the Fort à la Corne area of Saskatchewan, with Saskatchewan Energy and Mines and industry, and
  - geological research in the Flin Flon, Lynn Lake and Leaf Rapids areas in Manitoba, with Manitoba Industry, Trade and Mines.

In the Economic Statement and Budget Update of October 18, 2000, the Minister of Finance announced a temporary 15% investment tax credit for investors in flow-through shares of mineral exploration companies. This Investment Tax Credit for Exploration

(ITCE) is designed to assist junior mining companies in raising new equity through the issuance of flow-through shares and applies to eligible exploration expenses incurred after October 17, 2000, and before January 1, 2004.

In addition to the federal ITCE, several of the provincial governments have established similar tax credit programs. As part of its December 4, 2000, Economic and Fiscal Statement, the Ontario government announced that it would provide a 5% tax credit for Ontario investors in mining flow-through shares. This tax credit measure would complement the federal ITCE program. In its March 30, 2001, budget, the Government of Saskatchewan introduced a 10% tax credit for individuals who purchase flow-through shares in junior mineral exploration companies. In September 2001, the Quebec government announced the extension of its existing enhanced deduction program for flow-through shares until the end of 2003. In its April 22, 2002, budget, the Government of Manitoba introduced a 10% personal income tax credit for resident investors in flow-through shares of qualifying mineral exploration companies.

In April, the Government of Ontario and Laurentian University in Sudbury, Ontario, signed an agreement for a four-year, $8 million program aimed at developing advanced technologies for mineral exploration. Laurentian's Mines and Minerals Research Centre will manage the Ontario Mineral Exploration Technologies Program (OMET) and will be assisted by a committee of technical advisors from industry, universities and the wider geoscience research community. This advisory committee will evaluate proposals and make recommendations to the OMET Management Board, which will comprise officials from the Ontario Geological Survey, Ontario university geology departments, and the Chair of the Ontario Geological Survey Advisory Board.

In July, the Yukon government and North American Tungsten Corporation Ltd. signed a road maintenance agreement in support of the company's re-opening of its CanTung tungsten mine in the Northwest Territories. The agreement provides for the Yukon to spend approximately $900 000 on the re-opening, upgrading and maintenance of the Nahanni Range Road to the Yukon/Northwest Territories border, which is the only road access to the mine site. Once in operation, year-round maintenance will be shared, with the company responsible for approximately 70 km from the mine site, of which some 13 km are in the Northwest Territories and the balance is in the Yukon.

In August, the Government of British Columbia announced that, effective July 31, 2001, individuals who invest in flow-through shares may claim a credit equal to 20% of their British Columbia flow-through mining expenditures to reduce British Columbia income tax. The Mining Flow-through Share Tax Credit is a non-refundable credit and any unused credit at the end of a taxation year may be carried back three years or carried forward ten years. The existing METC (Mining Exploration Tax Credit) 20% tax credit would remain for companies that do not use flow-through shares to finance their exploration activities.

In August, it was announced that the Canada-Quebec Infrastructure Work Program would provide $6.6 million of the $7.1 million required to relocate part of Highway 117 near Val-d'Or, Quebec, with McWatters Mining Inc. providing the balance. The relocation would enable McWatters to expand its open-pit operations at its Sigma-Lamaque gold mine.

In November, the Yukon government announced that the Yukon Mineral Exploration Tax Credit had been extended until April 1, 2003. The tax credit was implemented on April 1, 1999, to encourage mineral exploration in the Yukon. Under the program, individuals and corporations can apply for a tax credit of up to 25% for eligible off-mine-site mineral exploration expenditures. Prior to April 1, 2001, the rate was 22%. In the same month, the Yukon government announced increased funding of $850 000 for the Yukon Mining Incentives Program and a commitment of $500 000 for the Regional Mineral Development Program.

Also in November, the Department of Indian Affairs and Northern Development (DIAND) and Miramar Giant Mine Ltd., a wholly owned subsidiary of Miramar Mining, signed an agreement to extend the life of the Giant gold mine near Yellowknife, Northwest Territories. Miramar will continue to source Giant ore as a supplemental feed to its nearby Con mill while DIAND will contribute $300 000 per month towards environmental compliance and holding costs.

In December, the Northern Ontario Heritage Fund Corporation (Heritage Fund) provided $3 047 700 to the Ontario Prospectors Association (OPA) to complete the restructuring of the association. In November 2000, the Heritage Fund had provided nearly $1 million as the first phase of a two-phase $4 million investment. With the government funding, the OPA has been restructured into a more modern, professionally staffed association to serve the prospecting community in Ontario. In addition, it will now have the resources to partner with industry to leverage more investments in grass-roots mineral exploration opportunities.

Also in December, the Government of Saskatchewan revised its royalty regime for uranium production in the province to include a basic and a tiered royalty effective January 1, 2001. The basic royalty remains unchanged at 5% of gross sales of uranium and is reduced by the province's resource credit equal to 1% of the gross sales of uranium. The tiered royalty is also based on gross sales of uranium, but only applies if the sales price of uranium exceeds prescribed levels adjusted for inflation and is only applicable after reductions for any capital allowances for a new mine or mill construction and certain mill expansions. Under the new regime, the marginal tax rate ranges from 4% to 19%, compared to 4% to 50% under the former regime.

PROFILES OF THE LEADING MINERALS PRODUCED IN CANADA

Gold

Canada has a long history of being one of the world's leading producers of gold. In 2000, Canada was the fifth largest global gold producer, trailing South Africa, the United States, Australia and China. Canada-based Barrick Inc. and Placer Dome Inc. are two of the top global gold-producing companies. Regionally, gold mining is carried out in all provinces and territories with the exception of New Brunswick, Nova Scotia and Prince Edward Island. Gold refineries are located in Quebec and Ontario. The main use for gold is in jewellery manufacturing with other important uses including electronics, dentistry and coinage.

In 2001, gold was Canada's leading metal as the value of gold shipments increased by 2.9% to $2.1 billion. The volume of shipments increased by 2.2% to 157 854 kg.

Copper

In global terms in 2000, Canada was ranked as the fifth leading producer of copper behind Chile, the United States, Indonesia and Australia. Canada-based Noranda Inc., Hudson Bay Mining and Smelting Co. Limited and Inco Limited are major world producers of copper. Regionally, copper is mined in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan and British Columbia. Primary smelters are located in Quebec, Ontario and Manitoba with refineries in Quebec, Ontario and British Columbia. Copper's properties, especially its high electrical and thermal conductivity, good tensile strength, relatively high melting point and resistance to corrosion, make it and its alloys attractive for electrical transmission, water tubing, castings and heat exchangers.

In 2001, the value of copper production in Canada decreased by 9.8% to $1.5 billion with production down by 1.7% to 611 160 kg. In value terms, copper was Canada's third leading metal in 2001.

Zinc

Canada was the world's third largest producer of zinc in 2000, trailing China and Australia and ahead of Peru and the United States. Canada-based Teck Cominco Ltd. and Noranda Inc. are two of the largest zinc producers in the world. Regionally, zinc is mined in New Brunswick, Quebec, Ontario, Manitoba, Saskatchewan, British Columbia and Nunavut, with metallurgical plants located in Quebec, Ontario, Manitoba and British Columbia. The main uses of zinc are as a coating (galvanizing) for steel to protect it from corrosion, the manufacture of brass and bronze, and die-casting.

In 2001, the value of zinc production decreased by 9.6% to $1.4 billion, although production increased by 7.9% to 1 009 571 kg. Zinc was Canada's fourth leading metal based on value of production.

Nickel

Canada is the world's third leading nickel producer behind Russia and Australia. In 2001, the next leading producers were New Caledonia and Indonesia. Globally, the industry is relatively small and is dominated by several large producers, including Canada-based Inco Limited and Falconbridge Ltd. Nickel is mined in the provinces of Ontario, Manitoba and Quebec, with smelters in Ontario and Manitoba and refineries in Ontario and Alberta. Nickel's resistance to corrosion, high strength, pleasing appearance and suitability make it useful in many applications. Major markets include stainless steels (which use about 65% of nickel production), nickel and copper-based alloys, electroplating, alloy steels, and foundry products.

In 2001, the value of Canadian nickel production fell by 24.2% to $1.8 billion, even though production amounted to 183 643 kg, an increase of 1.4% over 2000. Based on its value of production, nickel was Canada's second leading metal in 2001.

Iron Ore

Historically, Canada has been a major producer of iron ore with North American steel producers being the major users of Canadian-mined iron ore. In global terms, however, Canada ranked eighth in production in 2000 behind Brazil, Australia, China, Russia, India, the United States and Ukraine. The major Canadian-based producers of iron ore are the Iron Ore Company of Canada and Quebec Cartier Mining Company. Regionally, production takes place in Newfoundland and Labrador, Quebec and British Columbia. Iron ore is upgraded in Canada for steelmaking use as pellets, concentrates or sinter.

In 2001, the value of Canadian production fell by 18.9% to $1.2 billion, with production falling by 23.5% to 27 Mt. Iron ore was Canada's seventh leading mineral commodity in terms of value.

Uranium

Canada is the world's largest producer and supplier of uranium with exports accounting for about 80% of production. Globally, in 2000, the next leading producing countries were Australia, Niger, Namibia and Uzbekistan. All Canadian production occurs in Saskatchewan, with Canada-based Cameco Corporation being the world's largest producer. Cameco operates Canada's only uranium refining and conversion facilities, which are located in Ontario. Uranium is used principally as a fuel for nuclear power generating plants.

In 2001, the value of shipments from mines in Canada increased by almost 25% to nearly $675.6 million with volume shipped of 12 992 tU, up by 31%. The value of uranium mine production was up almost 25% to about $600 million for the 12 522 tU produced, a 17% increase.

Potash

Potash refers to a group of potassium-bearing minerals and chemicals. The dominant potash product is potassium chloride, a naturally occurring pink, salty mineral for which Canada is the world's leading producer and exporter. Internationally in 2000, Russia, Belarus, Germany, Israel and Jordan were the other leading producers. Regionally in Canada, potash is produced in Saskatchewan and New Brunswick with the Potash Corporation of Saskatchewan Inc. being the largest potash producer and exporter in the world. Fertilizer use consumes over 90% of the output. Other uses include detergents, ceramics, chemicals and pharmaceuticals.

The value of Canadian production fell by 3.9% in 2001 to $1.6 billion as the production volume fell by 9.4% to 8184 t.

Diamonds

Canada became a diamond producer in 1998 with start-up of the Ekati mine in the Northwest Territories. The first full year of production was 1999. On a global scale, it is estimated that, in 2000, Canada ranked seventh in terms of the value of diamond production. This ranking will rise with the scheduled start-up of the Diavik mine in 2003 and the Snap Lake project in 2006 in the Northwest Territories. Besides jewellery manufacturing, tools and equipment manufacturing are important markets for diamonds.

In 2001, the value of diamond production in Canada increased by 35.5% to $846.9 million as production rose by 51.3% to 3685 ct.

OUTLOOK AND TRENDS FOR THE CANADIAN MINERALS AND METALS INDUSTRY

The flat to negative economic growth experienced globally, particularly in the last six months of 2001, is expected to turn around by the middle of 2002. Weaker consumer spending, excess inventories and diminished industrial investment, much of which were evident before September, and the terrorist attacks in the United States on September 11th, all contributed to the slowdown in economic activity. Globally, a U.S.-led revival in 2002 is expected to benefit all industrialized economies, and particularly Canada's as the bulk of Canada's exports flow into the United States. In addition, an early recovery in Asia appears likely. In Canada, continued low interest rates, minimal inflation rates, lower energy prices, the effects of government tax cuts and continued aggressive sales incentives by manufacturers and retailers are expected to be the foundation for an economic recovery in 2002.

As 2001 came to a close, most economists were beginning to raise their expectations for the Canadian economy in 2002 as there were signs that the slowdown, which began in 2001, may be shorter and less severe than initially thought. Strong consumer spending continued to underpin the economy. Most economists are forecasting Canadian GDP growth of about 3.0-3.5% in 2002, compared to the 1.5% experienced in 2001. For 2003, strong growth is expected to continue with real GDP expected to rise by about 3.6%.

Globally, forecasters are looking at about 2.8% GDP growth in 2002, up from the 2.5% growth in 2001. A 4.0% growth rate is forecast for 2003. The U.S. economy is forecast to increase by about 3.0% in 2002 and perhaps by slightly more than that in 2003. The Euro Zone is expected to experience growth of about 1.0% in 2002 and about 3.0% in 2003. South America (excluding Mexico) is looking at negative growth of about 1.5% in 2002 with a recovery of perhaps 3.0% growth in 2003, although continuing financial difficulties in Argentina and Venezuela may jeopardize this. Mexico's economy is expected to grow by about 1.7% in 2002 and by a robust 4.5% in 2003. Japan's economy is forecast to decline by 1.0% in 2002 and to grow by 1.1% in 2003. South Korea is expected to grow strongly by 5.5% in 2002 and by 6.0% in 2003, with China at 7.3% in 2002 and 7.5% in 2003.

The health of the global minerals and metals industry suffered in 2001 with softer demand conditions coupled with overcapacity for many mineral commodities, particularly the major base metals, crippling the industry and causing most commodity prices to remain weak for much of the year. Prices should firm up in 2002 with improving demand conditions as the global economy recovers and the effects of consolidations, mergers and closures in certain mining sectors take hold. Consequently, overall minerals and metals supply should be more in line with expected demand conditions.

The Canadian minerals and metals industry should benefit from the expected upturn in global economic activity. The firming of gold prices in late 2001, which has continued into early 2002, should benefit many Canadian companies. While new mine development will remain weak, exploration activity should strengthen, principally due to higher gold prices, investment incentives and the ongoing strong interest in diamonds in many parts of Canada.

Notes: (1) Information in this review was current as of July 19, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. CANADA, PRODUCTION OF LEADING MINERALS, 2000 AND 2001

		Volume		Percent Change	Value		Percent Change
		2000 (r)	2001 (p)	2001/2000	2000 (r)	2001 (p)	2001/2000
		(000 tonnes except where noted)			($ millions)		
METALS							
Gold	kg	154 384	157 854	2.2	2 053.8	2 112.4	2.9
Nickel		181	184	1.4	2 323.8	1 763.3	-24.1
Copper		622	611	-1.7	1 684.1	1 520.6	-9.7
Zinc		936	1 010	7.9	1 567.3	1 416.4	-9.6
Iron ore		35 247	26 981	-23.5	1 424.4	1 155.2	-18.9
Uranium	tU	9 921	12 992	31.0	473.2	675.6	42.8
Platinum group	kg	15 304	18 154	18.6	478.5	568.8	18.9
Silver	t	1 169	1 224	4.7	279.0	267.9	-4.0
Lead		143	149	4.3	96.6	108.3	12.2
Cobalt	t	2 022	2 048	1.3	100.4	78.2	-22.1
Molybdenum	t	6 980	8 540	22.3	62.7	77.1	22.8
NONMETALS							
Potash (K_2O)		9 033	8 184	-9.4	1 644.2	1 581.5	-3.8
Cement		12 612	12 986	3.0	1 258.7	1 312.5	4.3
Sand and gravel		238 901	225 991	-5.4	971.2	953.2	-1.9
Stone		118 222	119 805	1.3	881.3	884.1	0.3
Diamonds	000 carats	2 435	3 685	51.3	624.9	846.9	35.5
Salt		12 164	13 548	11.4	351.4	449.5	27.9
Lime		2 525	2 221	-12.0	237.6	212.4	-10.6
Clay products		. .	. .	. .	175.4	195.2	11.3
Peat		1 277	1 187	-7.0	174.0	167.9	-3.5
Asbestos		310	294	-5.2	141.7	132.2	-6.7
Gypsum		8 572	8 119	-5.3	105.7	96.4	-8.7
Nepheline syenite		717	734	2.4	62.4	64.4	3.3
Quartz (silica)		1 508	1 567	3.9	41.2	41.4	0.3
Sulphur, in smelter gas		831	832	0.1	56.6	35.5	-37.3
Soapstone, talc, pyrophyllite		85	55	-35.3	25.5	16.6	-34.7
Sulphur, elemental		8 621	8 080	-6.3	92.4	1.2	-98.7
MINERAL FUELS							
Natural gas	million m^3	167 790	171 966	2.5	27 827.7	33 614.9	21.5
Petroleum, crude	000 m^3	127 609	130 526	2.1	30 523.6	25 941.3	-15.0
Natural gas by-products	000 m^3	30 543	29 789	-2.5	5 660.7	4 681.7	-17.3
Coal		69 163	70 361	1.7	1 427.4	1 546.8	8.4

Sources: Natural Resources Canada; Statistics Canada, *Canada's Mineral Production, Preliminary Estimates*, 2001, cat. no. 26-202-XIB.
. . Not available; (p) Preliminary; (r) Revised.
Notes: Numbers have been rounded. Percent changes are based on unrounded data.

TABLE 2. CANADA, VALUE OF DOMESTIC EXPORTS, TOTAL EXPORTS (INCLUDING RE-EXPORTS), IMPORTS AND BALANCE OF TRADE OF MINERALS AND MINERAL PRODUCTS, STAGES I-IV (CUSTOMS BASIS), 1997-2001

	1997	1998	1999	2000	2001
			($000)		
TOTAL MINING, INCLUDING FUELS					
Domestic exports	71 497 519	68 382 987	71 861 568	99 760 255	100 272 302
Total exports	72 967 313	69 521 529	73 031 845	101 236 115	102 016 024
Imports	50 001 459	53 725 050	55 326 622	69 388 071	64 160 286
Balance of Trade	22 965 854	15 796 479	17 705 223	31 848 044	37 855 738
NON-FUEL MINING					
Domestic exports	41 714 556	42 810 685	42 643 711	47 643 967	45 417 794
Total exports	42 544 308	43 799 352	43 671 837	48 954 023	46 746 568
Imports	37 152 635	42 913 543	43 763 988	50 004 848	45 313 316
Balance of Trade	5 391 673	885 809	-92 151	-1 050 825	1 433 252
TOTAL NON-FUEL MINING, INCLUDING COAL					
Domestic exports	44 449 126	45 333 227	44 688 047	49 516 640	47 402 881
Total exports	45 279 935	46 322 890	45 719 662	50 828 808	48 732 160
Imports	38 031 799	44 055 070	44 880 463	51 176 440	46 576 292
Balance of Trade	7 248 136	2 267 820	839 199	-347 632	2 155 868
TOTAL ECONOMY					
Domestic exports	280 033 595	297 509 218	331 433 928	385 363 738	373 447 193
Total exports	298 072 001	318 444 012	355 105 966	412 900 022	402 295 585
Imports	272 946 323	298 386 345	320 378 550	356 851 381	343 002 846
Balance of Trade	25 125 678	20 057 667	34 727 416	56 048 641	59 292 739

Sources: Natural Resources Canada; Statistics Canada.

Canadian Reserves of Selected Major Metals, and Recent Production Decisions

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RESERVES OF SELECTED MAJOR METALS

In 2000, Canadian reserves of copper, nickel, lead, zinc, molybdenum, silver and gold decreased because there were no decisions to bring new mines into production and the amount of new ore discovered at existing mining operations was insufficient to replace the quantity of ore that was mined during the year (Table 1). This continued a trend of declining ore reserves that began in the early 1980s for base metals and in the late 1980s for gold. During 2000, improving prices for copper, nickel and zinc were overwhelmed by deteriorating prices for lead, molybdenum and silver, together with the stagnant price of gold.

In Canada during 2000, there were no announcements of new production decisions for the seven metals reviewed in this chapter. Given that metal prices were generally depressed during 2001, it is probable that Canadian ore reserve levels for the major metals will continue to decline in the immediate future. The Voisey's Bay nickel-copper-cobalt deposit in Labrador is not presently included in Canadian reserves because there are major issues to be resolved before production can begin. When a production decision is made, it will result in significant increases in the reserves of nickel and copper.

Reserves Policy

Canadian reserves are estimated from information contained in annual and other corporate reports, and from the responses of mining companies to the annual Federal-Provincial Survey of Mines and Concentrators. Reserves reported here include only metal contained in material that is classified by companies as "proven" or "probable" (or their equivalents) at producing mines and in deposits that are firmly committed to production (Table 2). Metal contained in mineral resources classified by companies as "possible" (or its equivalents) is not included in national totals, nor is metal contained in deposits that have not advanced beyond the deposit appraisal phase (Figure 1). When available, only metal contained in mineable ore is included in Canadian totals to exclude losses inherent in the mining process. Every effort is made to achieve, from year to year, consistency in the reserves reported here; however, consistency ultimately depends on industry practice, which has evolved over the years. Imperial units reported by companies have been converted to metric units and the results have been rounded to the appropriate number of significant digits.

Reserves by Commodity

Gold

There were 1142 t of gold contained in Canadian mine reserves in December 2000. This represents a decrease of 14% (183 t) compared to December 1999. The major components of this decrease were the exhaustion of the Brewery Creek mine in the Yukon, the Golden Bear mine in British Columbia, and the Keystone mine in Manitoba, together with the depletion of reserves without sufficient replacement at most of the other gold mines in Canada. The only notable increase in gold reserves was reported at the Red Lake mine (+21 t) in Ontario.

Silver

There were 13 919 t of silver contained in Canadian mine reserves in December 2000. This represents a decrease of 9% (1451 t) compared to December 1999. The major components of this decrease were the closure of the Brewery Creek mine in the Yukon and the Keystone mine in Manitoba, together with the depletion without sufficient replacement of reserves at most of the silver-producing mines in Canada. None of the silver-producing mines reported significant increases in their reserves during 2000.

Figure 1
Generalized Model of the Mineral Resource Development and Mining Process

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRONMENTAL RESTORATION
		GRASS-ROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine development, construction of processing plant and infrastructure.	Production, marketing and renewal of reserves.	Mine complex closure and decommissioning, site restoration.
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade, quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest" to justify more intensive and detailed work.	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and realistically.	Obtain all the information required and determine, based on corporate objectives, parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustain-able development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new targets.	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Pre-feasibility studies	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Pre-feasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side factors.	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommissioning. Environmental restoration and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%; mining: ± 5%)		Full compliance
INVESTMENTS	Moderate	Low, but increasing multiple investments.					Larger and increasing multiple investments.				Very large industrial investment.		
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss.					High, but decreasing risk of failure.				Moderate to low industrial risk.		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

Zinc

During 2000, Canadian reserves of zinc declined by about 1.3 Mt (13%) to a year-end total of about 8.9 Mt. Zinc reserves decreased at almost all of the zinc producers. The only zinc mines to report an increase in ore reserves during 2000 were the Trout Lake and Chisel Lake North mines in Manitoba.

Lead

Canadian reserves of lead decreased by approximately 17% during 2000 to 1 315 000 t. This was largely because of the production without replacement of ore at the Brunswick No. 12 mine (-155 000 t) in New Brunswick, at the Sullivan mine (-94 000 t) in British Columbia, and the cessation of lead production at the Kidd Creek mine in Ontario.

Copper

In December 2000, Canadian reserves of copper were estimated at about 7.4 Mt, or down by about 4% (-345 000 t) from a year earlier. Copper reserves were reduced at the Louvicourt mine in Quebec (-70 000 t) and at the Mount Polley mine (-63 000 t) in British Columbia. Copper reserves were increased slightly at the Highland Valley Copper mine (+17 000 t) in British Columbia.

Molybdenum

Canadian reserves of molybdenum stood at 97 000 t in December 2000, or about 18% lower than in the previous year. This was principally due to the reduction of reserves at the Highland Valley Copper mine (-19 000 t). All of the molybdenum mines are in British Columbia.

Nickel

In December 2000, there were some 4.8 Mt of nickel contained in Canadian mine reserves, down by approximately 4% from 1999 levels. This decrease is due largely to reduced reserves at Inco Limited's Ontario Division (-138 000 t).

Inco had some 3.9 Mt of nickel in Canadian reserves at the end of 2000, or about 81% of the national total. It is expected that development of the copper-nickel-cobalt deposits at Voisey's Bay in Labrador will make major additions to Canada's mineable reserves of these metals in the near future.

Canadian Reserves by Province and Territory

Four provinces (Ontario, British Columbia, New Brunswick and Quebec) held dominant positions in terms of Canada's proven and probable mineable reserves of major metals in December 2000 (Table 4).

Ontario had 69% of the nickel, 52% of the gold and 50% of the copper, plus 21% of the silver and 19% of the zinc.

British Columbia had 100% of the molybdenum, 33% of the copper and 27% of the silver, plus 4% of the lead, 7% of the zinc and 16% of the gold.

New Brunswick had 85% of the lead, 32% of the zinc and 24% of the silver, plus 2% of the copper.

Quebec had 26% of the zinc, 23% of the gold, 8% of the copper, 12% of the nickel and 23% of the silver.

Manitoba had 20% of the nickel, 13% of the zinc and 6% of the gold, plus 7% of the copper and 4% of the silver.

Newfoundland and Labrador had less than 1% of the gold.

The Northwest Territories had 1% of the gold.

Nunavut had 4% of the lead, 4% of the zinc, 1% of the gold and less than 1% of the silver.

Canadian Reserves by Industry

Canadian mines are, to a large extent, polymetallic, a complexity that the Standard Industrial Classification (SIC) tends to oversimplify (Table 5).

Current mine reserves of gold in Canada are distributed through the various SIC classes as follows: gold mines, 81%; copper and copper-zinc mines, 15%; nickel-copper mines, 3%; and zinc-lead-silver mines, 1%.

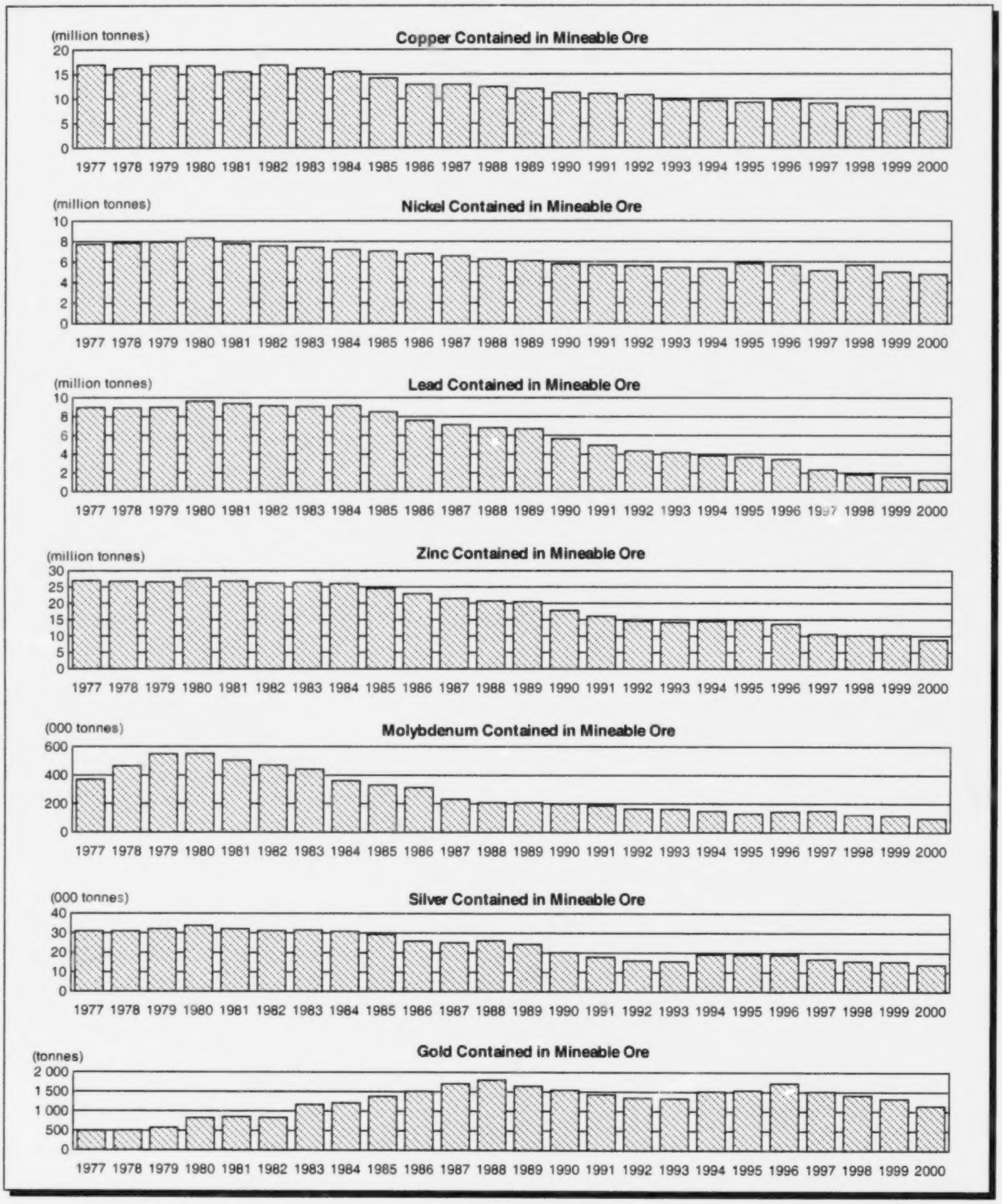
Current mine reserves of silver in Canada are distributed through the various SIC classes as follows: gold mines, 38%; copper and copper-zinc mines, 28%; nickel-copper mines, 8%; and zinc-lead-silver mines, 26%.

Current mine reserves of copper in Canada are distributed through the various SIC classes as follows: gold mines, 2%; copper and copper-zinc mines, 52%; nickel-copper mines, 44%; and zinc-lead-silver mines, 2%.

Current mine reserves of molybdenum in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 24%; and molybdenum mines, 75%.

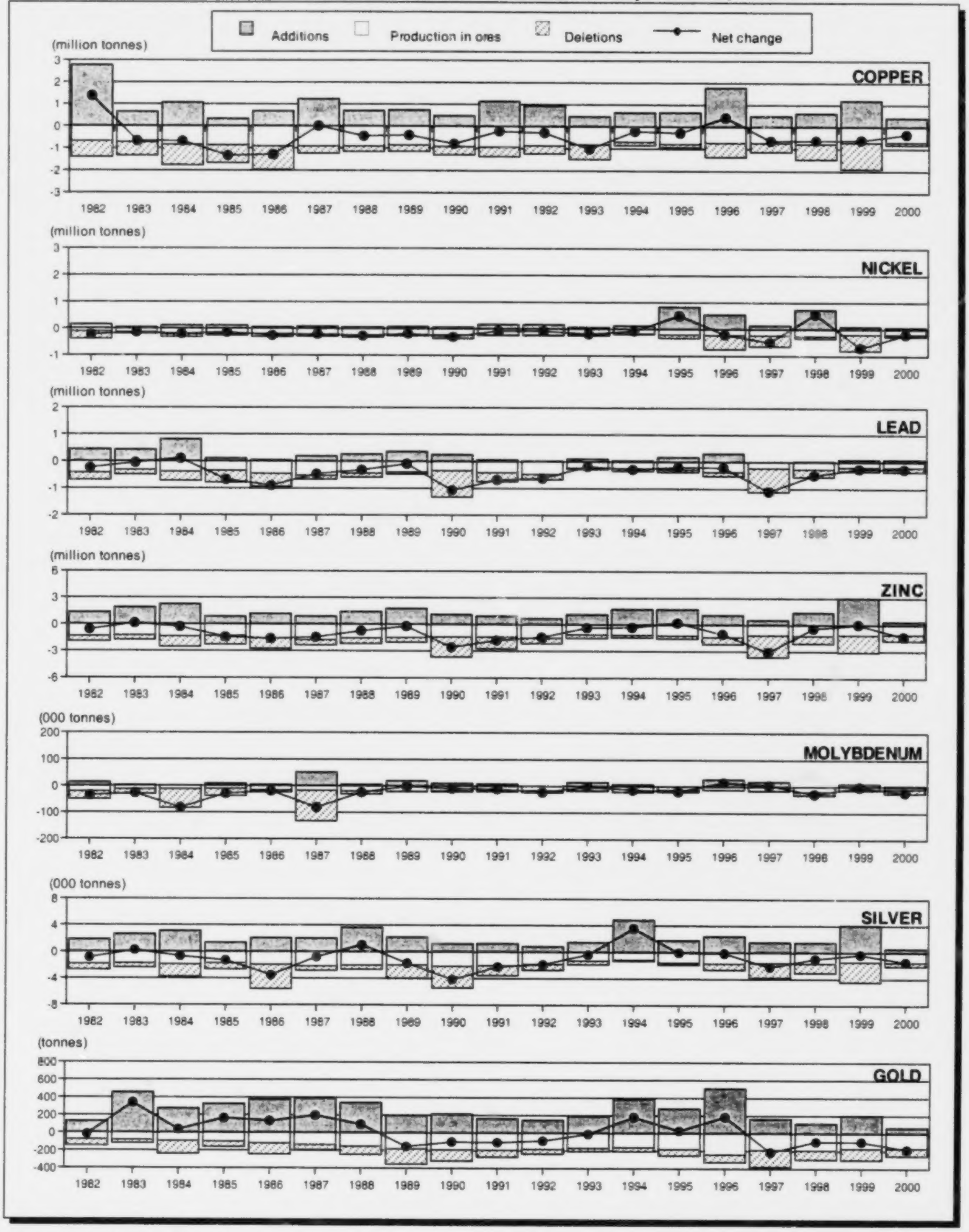
Current mine reserves of nickel in Canada are contained 99% in the SIC class of nickel-copper mines and 1% in the SIC class of miscellaneous metal mines.

Figure 2
Canadian Reserves of Selected Major Metals, 1977-2000
Metal Contained in Proven and Probable Mineable Ore in Operating Mines and Deposits Committed to Production, as at December 31 of Each Year



Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.
Note: This series was revised during 1996.

Figure 3
Main Components of Change in Canadian Reserves of Selected Major Metals, 1982-2000



Source: Natural Resources Canada.

Current mine reserves of lead in Canada are contained in the SIC classes as follows: copper and copper-zinc mines, 7%; and zinc-lead-silver mines, 93%.

Current mine reserves of zinc in Canada are contained in the SIC classes as follows: gold mines, 15%; copper and copper-zinc mines, 45%; and zinc-lead-silver mines, 40%.

Apparent Life of Canadian Reserves

The apparent life (life index) of mine reserves is usually calculated by dividing the total amount of metals remaining in mine reserves at the end of a given year by the corresponding amount of metals contained in the ores produced during that year. Similar calculations are often applied at the national level.

At the national level, life indices are but a very rough measure of the expected life of aggregate mine reserves and they are often misleading unless abnormal situations are recognized. Life indices based on proven and probable reserves do not make allowances for inferred extensions to reserves at current mines, gross additions that will accrue to current reserves from the likely development, in the foreseeable future, of known orebodies for which a production decision has yet to be made, or expected changes in production rates. Furthermore, life indices tend to overstate the apparent life of reserves when, for example, annual production is abnormally low due to strikes, cutbacks or suspensions at large establishments, or when significant increases in capacity resulting from new production decisions will be coming on stream, but only several years hence.

The apparent life indices for the major metals in Canada at the end of 2000 were 24 years for nickel, 12 years for molybdenum, 11 years for copper, 9 years for silver, 8 years for zinc, 7 years for gold and 7 years for lead.

Reserve Trends

Figure 2 and Table 6 show how Canadian reserves of copper, nickel, lead, zinc, molybdenum and silver have declined since the early 1980s. In contrast, gold reserves increased substantially until 1988 before beginning to decline. At the end of 2000, Canadian reserves of copper, nickel, lead, zinc, molybdenum, and silver were all lower than at any time since Natural Resources Canada began keeping records (1977), and reserves of gold were lower than in any year since 1982.

The annual aggregate change in Canadian reserves is the net result of three main factors affecting individual mines (Figure 3): additions to reserves, deletions to reserves, and production. Additions to reserves are the result of new discoveries; of new geological, metallurgical, production or other information; of a decrease in production costs; or of a rise in commodity prices, all of which increase the quantity of mineral resources that are profitable to mine. Deletions to reserves are the result of new geological, metallurgical, production or other information; of increases in costs; or of decreases in commodity prices, all of which reduce the quantity of mineral resources previously counted in mine reserves that are now expected to be mined at a profit. Production is normally the main factor reducing the reserves at individual mines but, in 2000, low metal prices were a significant factor in the reduction of ore reserves at producing mines.

RECENT PRODUCTION DECISIONS

Several criteria need to be met for a project to be considered here to have reached the production decision stage. In general, there needs to have been a positive production feasibility study, all of the necessary permits must have been obtained, financing must have been arranged, and directors must have approved construction.

During 2000, there were no new production decisions for deposits of copper, nickel, lead, zinc, molybdenum, silver or gold.

Inco Limited's Voisey's Bay deposit in Labrador is poised for a production decision, but it is not included as a 2001 production decision because not all of the necessary permits and agreements were in place at that time.

OUTLOOK

Given that the only new production decision during 2001 was the Hammerdown mine (6 t of gold) in Newfoundland and Labrador and that prices of most of the metals covered in this chapter remained low during 2001, it is probable that mine reserves of precious metals and base metals will decline further during 2001.

At the Voisey's Bay nickel-copper-cobalt deposit, Inco has established proven reserves of 31 Mt grading 2.9% nickel, 1.7% copper and 0.14% cobalt. If these figures are confirmed and the obstacles to production are resolved, Voisey's Bay will increase Canada's nickel reserves by 899 000 t (about 19% of present reserves) and the reserves of copper by 527 000 t (about 7% of present reserves).

Notes: (1) Information in this review was current as of February 11, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. MAIN COMPONENTS OF CHANGE DURING 2000 IN CANADIAN RESERVES OF SELECTED MAJOR METALS

Metal	Units	Revised Opening Metal Balance, January 2000	Metal in Ore Mined Ore Mined During 2000	Metal Apparently Written Off During 2000	Metal in New Reserves Found During 2000	Net Change During 2000	Closing Metal Balance, December 2000	% Change During 2000
Copper	000 t	7 761	-690	-117	414	-345	7 419	-4
Nickel	000 t	4 983	-200	-69	68	-201	4 782	-4
Lead	000 t	1 586	-202	-152	88	-271	1 315	-17
Zinc	000 t	10 210	-1 089	-697	362	-1 335	8 876	-13
Molybdenum	000 t	118	-8	-17	3	-22	97	-18
Silver	t	15 371	-1 490	-565	523	-1 451	13 919	-9
Gold	t	1 326	-170	-81	66	-183	1 142	-14

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

– Nil.

Note: May not balance due to rounding.

TABLE 2. TONNAGES AND GRADES OF OPERATIONS INCLUDED IN CANADIAN RESERVES OF SELECTED MAJOR METALS, AS AT JANUARY 1, 2001

Tonnages classified by companies as "possible" are not included where they are reported separately from proven and probable tonnages, nor are tonnages for deposits for which there is no firm production decision. Data reported in imperial units were converted to metric units and rounded to the corresponding number of significant digits. Confidential data have been suppressed from the details of this report.

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
NEWFOUNDLAND AND LABRADOR								
Nugget Pond								
Richmont Mines Inc.								
Proven and probable	105 233							8.57
NEW BRUNSWICK								
Brunswick No. 12 Underground								
Noranda Inc.								
Proven and probable	32 217 000	0.38		3.47	8.75		104.00	0.07
QUEBEC								
Beaufor								
Richmont Mines Inc.								
Louvem Mines Inc.								
Proven	303 000						0.50	7.40
Probable	768 000						0.50	7.60
Bell Allard								
Noranda Inc.								
Proven	2 552 000	1.18					36.00	0.60
Probable	357 000	1.62			14.17		51.00	0.60
Bouchard-Hébert								
Cambior inc.								
Proven and probable	4 414 000	0.70			4.90		36.00	1.10
Bousquet No. 2								
Barrick Gold Corporation								
Proven	330 215	0.20					..	5.44
Probable	1 319 954	0.20					..	5.44
Doyon								
Cambior inc.								
Proven and probable	7 500 000						..	6.00
Francoeur								
Richmont Mines Inc.								
Proven and probable	129 727						0.45	7.54
Gallen								
Noranda Metallurgy Inc.								
Probable	75 000	0.05			1.56		31.00	1.00
Joe Mann								
Campbell Resources Inc.								
Proven	214 277						4.98	8.90
Probable	83 007						..	10.89
Kiena								
McWatters Mining Inc.								
Proven and probable	2 100 000						0.70	3.74
Langlois								
Cambior inc.								
Proven and probable	3 892 000	0.60			10.20		49.00	0.10
LaRonde								
Agnico-Eagle Mines Limited								
Proven and probable	30 532 210	0.32			4.40		72.78	3.11
Louvicourt								
Aur Resources Inc.								
Novicourt Inc.								
Teck Corporation								
Proven	5 408 000	3.21			1.78		27.00	0.90
Probable	204 000	2.27			0.55		18.00	0.50
Raglan								
Falconbridge Limited								
Proven	6 565 000	0.77	2.94					
Probable	12 937 000	0.79	2.81					

TABLE 2 (cont'd)

		Grade						
	Tonnes	Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
QUEBEC (cont'd)								
Selbaie A1 Open Pit								
Billiton Metals Canada Inc. (Gencor Ltd.)								
Proven and probable	11 700 000	0.35		..	1.26		23.00	0.27
Sigma No. 1								
McWatters Mining Inc.								
Proven	9 600 000						0.30	2.60
Probable	5 479 000						0.30	2.64
Sleeping Giant								
Aurizon Mines Ltd.								
Cambior inc.								
Proven	192 000						..	10.30
Probable	148 000						12.00	12.00
Troilus								
Inmet Mining Corporation								
Proven	9 100 000	0.10					1.10	0.90
Probable	21 500 000	0.10					1.10	1.10
ONTARIO								
Campbell								
Placer Dome North America								
Proven	1 847 000						1.00	14.70
Probable	1 352 000						..	16.00
David Bell								
Homestake Canada Inc.								
Teck Corporation								
Proven	3 664 000						1.50	10.35
Dome (including Paymaster)								
Placer Dome North America								
Proven	10 008 000						0.20	1.20
Probable	17 704 000						0.20	2.00
Eagle River								
River Gold Mines Ltd.								
Proven and probable	1 211 000						1.00	10.14
Edwards								
River Gold Mines Ltd.								
VenCan Gold Corporation								
Proven and probable	96 000						1.00	11.31
Falconbridge Sudbury Integrated Nickel Operations								
Falconbridge Limited								
Proven	10 178 000	1.30	1.61					
Probable	10 009 000	1.37	1.37					
Glimmer								
Exall Resources Limited								
Glimmer Resources Inc.								
Mineable	777 782							8.91
Golden Giant								
Newmont Mining Corporation								
Proven and probable	4 779 000						1.00	9.81
Holloway								
Battle Mountain Gold Company								
Teddy Bear Valley Mines, Limited								
Proven and probable	3 981 634						0.65	6.69
Holt-McDermott								
Barrick Gold Corporation								
Proven	327 494						0.62	6.31
Probable	1 566 708						0.65	6.75
Hoyle Pond								
Kinross Gold Corporation								
Proven	362 000						0.05	12.20
Probable	568 000						0.05	12.40
Inco Ontario Division								
Inco Limited								
Proven	86 000 000	1.13	1.27				..	0.15
Probable	139 000 000	1.29	1.32				..	..

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
ONTARIO (cont'd)								
Kidd Creek								
Falconbridge Limited								
Proven	16 971 000	2.27			5.62		70.00	
Probable	10 285 000	2.25			5.58		54.00	
Lac des Iles								
North American Palladium Ltd.								
Proven	61 534 000	0.06	0.05					0.12
Probable	34 509 000	0.05	0.05					0.12
Musselwhite								
Placer Dome North America								
TVX Gold Inc.								
Proven	11 544 000							5.58
Probable	2 664 700							4.80
Red Lake								
Goldcorp Inc.								
Proven	969 781						6.86	50.40
Probable	1 908 717						3.43	32.57
Williams								
Homestake Canada Inc.								
Teck Corporation								
Proven (underground)	9 950 000						0.70	6.19
Proven (open pit)	807 000						0.10	1.60
Probable (underground)	7 402 000						0.70	5.04
Probable (open pit)	4 592 000						0.30	2.21
MANITOBA								
777								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	9 200 000	2.80			4.40		33.00	. .
Bissett								
Harmony Gold Mining Company Limited								
Mineable	1 850 000						. .	6.50
Callinan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	2 800 000	1.20			5.00		. .	2.00
Chisel Lake North								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	2 400 000	. .		0.20	10.50		. .	
Inco Manitoba Division								
Inco Limited								
Proven	22 000 000	0.15	2.37				. .	0.04
Probable	20 000 000	0.13	2.14				. .	0.04
New Britannia								
High River Gold Mines Ltd.								
TVX Gold Inc.								
Reserves	2 202 000						0.50	5.90
Ruttan								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	6 700 000	1.00			1.70		. .	0.44
Trout Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	4 800 000	1.30			4.40		. .	1.33
SASKATCHEWAN								
Konuto Lake								
Hudson Bay Mining and Smelting Co., Limited								
Proven and probable	900 000	4.30			1.60		. .	2.35
Seabee								
Claude Resources Inc.								
Mineable	579 349						0.20	7.54

TABLE 2 (cont'd)

	Tonnes	Grade						
		Cu	Ni	Pb	Zn	Mo	Ag	Au
		(%)	(%)	(%)	(%)	(%)	(g/t)	(g/t)
BRITISH COLUMBIA								
Endako								
Nissho Iwai Corporation								
Thompson Creek Mining Limited								
Proven and probable	. .					0.07		
Denak	. .					0.08		
Low-grade stockpile	. .					0.04		
Eskay Creek								
Prime Resources Group Inc.								
Reserves	1 466 918						2 026.29	44.91
Highland Valley Copper								
Cominco Ltd.								
Highmont Mining Company								
Billiton Copper Holdings Inc.								
Teck Corporation								
Proven	336 100 000	0.42				. .	. .	. .
Probable	52 500 000	0.44				. .	1.00	0.01
Huckleberry								
Mitsubishi Corporation, Dowa Mining Co., Ltd., Furukawa Co. Ltd., Marubeni Corporation								
Imperial Metals Corporation								
Probable	56 498 000	0.49				0.01	2.81	0.06
Kemess South								
Northgate Exploration Limited								
Proven	145 911 264	0.23						0.65
Mount Polley								
Imperial Metals Corporation								
Sumitomo Corporation								
Probable	30 245 122	0.36						0.37
Myra Falls								
Boliden Westmin (Canada) Limited								
Proven and probable	7 716 000	1.30			6.60		. .	0.60
Sullivan								
Cominco Ltd.								
Proven	1 800 000			3.20	6.60		9.48	
NORTHWEST TERRITORIES								
Con								
Miramar Mining Corporation								
Proven	848 000						3.00	12.00
Probable	290 000						3.00	12.00
Giant Open Pit-Giant Underground								
Miramar Mining Corporation								
Proven	35 000						2.00	14.00
Probable	82 000						3.00	12.20
NUNAVUT								
Lupin								
Echo Bay Mines Ltd.								
Proven and probable	1 522 256						. .	8.88
Nanisivik								
Nanisivik Mines Ltd.								
Proven and probable	2 868 000			0.40	6.90		28.00	
Polaris								
Cominco Ltd.								
Pine Point Mines Limited								
Proven	1 400 000			2.90	12.10			

Source: Natural Resources Canada, based on published company reports.

. . Not available in published reports or estimated by author.

Notes: One tonne (t) = 1.1023113 short tons. One gram per tonne (g/t) = 0.02916668 troy ounces per short ton.

TABLE 3. PRODUCTION DECISIONS ADDED TO CANADIAN RESERVE TOTALS AS AT DECEMBER 31, 2000

Project	Operators and Major Partners	Province	Metals
There were no production decisions in 2000.			

Source: Natural Resources Canada, based on company reports.

TABLE 4. CANADIAN RESERVES OF SELECTED MAJOR METALS BY PROVINCE AND TERRITORY, AS AT DECEMBER 31, 2000

Metal Contained in Proven and Probable Mineable Ore [1] in Operating Mines [2] and Deposits Committed to Production

Metal	Units (3)	Nfld.	N.S.	N.B.	Que.	Ont.	Man.	Sask.	B.C.	Yukon	N.W.T.	Nunavut	Canada (5)
Copper	000 t	–	–	122	597	3 705	485	39	2 474	–	–	–	7 419
Nickel	000 t	–	–	–	557	3 276	949	–	–	–	–	–	4 782
Lead	000 t	–	–	1 118	82	–	5	–	58	–	–	52	1 315
Zinc	000 t	–	–	2 819	2 274	1 672	1 122	14	628	–	–	367	8 876
Molybdenum	000 t	–	–	–	–	–	–	–	97	–	–	–	97
Silver	t	–	–	3 351	3 185	2 919	615	8	3 768	–	4	82	13 919
Gold (4)	t	1	–	2	260	596	65	6	184	–	15	14	1 142

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

– Nil or less than one unit.

(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes geological reserves for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. (4) Excludes metal in placer deposits because reserves data are generally unavailable. (5) May not balance due to rounding at the provincial/territorial level.

TABLE 5. CANADIAN RESERVES OF SELECTED MAJOR METALS BY INDUSTRY, AS AT DECEMBER 31, 2000

Metal Contained in Proven and Probable Mineable Ore [1] in Operating Mines [2] and Deposits Committed to Production

		Gold Mines	Copper, Copper-Zinc Mines	Nickel-Copper Mines	Zinc-Lead-Silver Mines	Molybdenum Mines	Miscellaneous Metal Mines	
	SIC no. (5)	611	612	613	614	615	619	Canada (6)
	(Units (3))							
Copper	000 t	132	3 836	3 246	153	–	54	7 419
Nickel	000 t	–	–	4 734	–	–	48	4 782
Lead	000 t	–	87	–	1 228	–	–	1 315
Zinc	000 t	1 343	4 031	–	3 521	–	–	8 876
Molybdenum	000 t	–	23	–	–	73	–	97
Silver	t	5 324	3 858	1 143	3 607	–	–	13 919
Gold (4)	t	921	168	35	7	–	12	1 142

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and Concentrators.

– Nil or less than one unit.

(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces. (4) Excludes metal in placer deposits because reserves data are generally unavailable. (5) SIC Standard Industrial Classification. (6) May not balance due to rounding at the SIC level.

TABLE 6. CANADIAN RESERVES OF SELECTED MAJOR METALS AS AT DECEMBER 31 OF EACH YEAR, 1977-2000

Metal Contained in Proven and Probable Mineable Ore[1] in Operating Mines[2] and Deposits Committed to Production

Year	Copper	Nickel	Lead	Zinc	Molybdenum	Silver	Gold (3)
	(000 t)	(000 t)	(000 t)	(000 t)	(000 t)	(t)	(t)
1977	16 914	7 749	8 954	26 953	369	30 991	493
1978	16 184	7 843	8 930	26 721	464	30 995	505
1979	16 721	7 947	8 992	26 581	549	32 124	575
1980	16 714	8 348	9 637	27 742	551	33 804	826
1981	15 511	7 781	9 380	26 833	505	32 092	851
1982	16 889	7 546	9 139	26 216	469	31 204	833
1983	16 214	7 393	9 081	26 313	442	31 425	1 172
1984	15 530	7 191	9 180	26 000	361	30 757	1 208
1985	14 201	7 041	8 503	24 553	331	29 442	1 373
1986	12 918	6 780	7 599	22 936	312	25 914	1 507
1987	12 927	6 562	7 129	21 471	231	25 103	1 705
1988	12 485	6 286	6 811	20 710	208	26 122	1 801
1989	12 082	6 092	6 717	20 479	207	24 393	1 645
1990	11 261	5 776	5 643	17 847	198	20 102	1 542
1991	11 040	5 691	4 957	16 038	186	17 859	1 433
1992	10 755	5 605	4 328	14 584	163	15 974	1 345
1993	9 740	5 409	4 149	14 206	161	15 576	1 333
1994	9 533	5 334	3 861	14 514	148	19 146	1 513
1995	9 250	5 832	3 660	14 712	129	19 073	1 540
1996	9 667	5 623	3 450	13 680	144	18 911	1 724
1997	9 032	5 122	2 344	10 588	149	16 697	1 510
1998	8 402	5 683	1 845	10 159	121	15 738	1 415
1999	7 761	4 983	1 586	10 210	119	15 368	1 326
2000	7 419	4 782	1 315	8 876	97	13 919	1 142

Source: Natural Resources Canada, based on company reports and the Federal-Provincial Survey of Mines and

(1) No allowance is made for losses in milling, smelting and refining. Excludes material classified as "possible." Includes "geological reserves" for some mines that do not report mineable ore. (2) Includes metal in mines where production has been suspended temporarily. (3) Excludes metal in placer deposits because reserves data are generally unavailable.

Note: One tonne (t) = 1.1023113 short tons = 32 150.746 troy ounces.

Mineral Exploration, Deposit Appraisal and Mine Complex Development Activity in Canada

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INTRODUCTION

This review provides analytical highlights and describes mineral resource development activities from primary exploration to mine production in Canada (focussing on 2001) with emphasis being placed on mineral exploration and deposit appraisal expenditures. Also briefly discussed are the revised spending intentions (as of August 2002) for the survey year 2002, as well as other exploration indicators such as drilling and claim-staking activity. The 2000 and 2001 final data used for the analysis are presented in the statistical tables at the end of this chapter.

Expenditures are compiled from the federal-provincial-territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures, which is briefly described in the Background section at the end of this chapter. This annual survey of exploration and mining companies provides an accurate measure of overall mineral development activity in Canada. In 2001, the response rate to that survey was 96%. The results were compiled from the reports of 616 active company project operators and 38 prospectors or groups of prospectors. All 38 prospectors and 491 of these companies reported that they were active in mineral exploration while 70 were active in deposit appraisal and 115 in mine complex development. (Note: Some companies are involved in more than one work phase at the same time.)

TRENDS AND PERSPECTIVE

Exploration and deposit appraisal expenditures by both junior and senior companies (definitions are provided below) appear to have stabilized since 1999. Expenditures declined slightly from $504.3 million in 1999 to $496.7 million in 2000. Final figures for 2001 indicate that expenditures increased by a small amount to $512.9 million, and company revised spending intentions for 2002 (as of August 2002) again indicate expenditures topping the $500 million mark.

At the same time as exploration and deposit appraisal spending by seniors has declined each year since 1999, spending by juniors has increased from $141.4 million in 1999 to $177.7 million in 2001. A further significant increase is anticipated for 2002 to almost $210 million. Off-mine-site exploration expenditures (excluding deposit appraisal) for these years parallel the totals, rising each year from $92.9 million in 1999 to an expected $167.9 million in 2002 for junior companies.

Historically (Tables 3a and 3b, and Figure 2), after unprecedented levels of exploration and deposit appraisal expenditures were reached in 1987 and 1988, principally as a result of the Canadian Mining Exploration Depletion Allowance (MEDA), expenditures fell, reaching in 1992 their lowest level since 1972. Higher metal prices and significant diamond and nickel-copper discoveries in the early to mid-1990s led to a resurgence in expenditures in 1996 and 1997. Lower metal prices through the latter part of the 1990s and reduced investor confidence as a result of the Bre-X exploration incident in Indonesia and the Asian financial crisis led to the latest decline in exploration and deposit appraisal expenditures. However, improvement is now being seen as exploration and deposit appraisal expenditures in 2001 reached their highest point since 1998. When all the data for 2002 have been compiled, expectations are that expenditure levels will at least be maintained. The impact of government initiatives since 2000, aimed at assisting junior exploration companies in obtaining financing for their off-mine-site exploration programs, still remains to be fully assessed. Indications for 2002 are that these initiatives have contributed to increased junior off-mine-site exploration spending and probably have offset the effect of low commodity prices. On the other hand, senior exploration expenditures off-mine-site still appear to be declining.

Low metal prices represent the most important factor influencing mineral resource development expenditures over the 1999 to 2001 period. For example, copper, which traded at US$1.18/lb in June 1997, averaged only US$0.716/lb in 2001 and for the first nine months of 2002 averaged just over US$0.70/lb. Zinc, which traded at US$0.750/lb in August 1997, averaged US$0.402/lb in 2001 and through September 2002 averaged only US$0.354/lb. Nickel prices have fared slightly better, averaging US$3.92/lb in 2000, its highest yearly average since 1990. However, nickel prices averaged only US$2.10/lb in 1998, US$2.73/lb in 1999 and US$2.73/lb in 2001. In the first nine months of 2002, the price of nickel recovered somewhat to average US$3.02/lb. Gold prices, with the exception of 2002, have been in the doldrums for several years, averaging about US$275/oz over the 1999-2001 period. This compares to a recent annual average high of US$387.69/oz in 1996. Gold prices have strengthened in 2002 and, in September, averaged about $320/oz. Uncertainty in the equity markets, low interest rates and the unsettled world situation have contributed to the recent strength in gold prices.

Metal prices in general are not expected to rise much in the near term with uncertain global economic conditions, but the recent strength shown by nickel, and especially gold, two minerals traditionally targeted for exploration, gives rise to some optimism for the future. The high platinum and palladium prices of 2000 and 2001 (palladium prices averaged about US$680/oz in 2000 and US$604/oz in 2001; platinum averaged US$544/oz in 2000 and US$529/oz in 2001) have also spurred interest in those metals. From about $4.5 million in exploration and deposit appraisal expenditures in 1998 for platinum group metals (PGM), companies have increased their search for these metals significantly with expenditures reaching about $30 million in 2001. This is another indication of how metal prices influence exploration decisions. Palladium prices have weakened in 2002, trading at about US$325/oz in the third quarter. Platinum prices have ranged from about US$450/oz to US$575/oz in 2002 and traded at about US$545/oz in the third quarter.

Exploration for diamonds is not driven by an international market price. However, changes in the economy, demography and structure of the diamond industry do have an impact on diamond prices.

Spending by senior companies was more noticeably affected by the low metal prices. In fact, expenditures by these companies on exploration and deposit appraisal in Canada declined from $362.9 million in 1999 to $335.1 million in 2001. A further drop to $291.8 million is anticipated for 2002, based on revised spending intentions. However, exploration and deposit appraisal expenditures on diamonds may mask a more severe decline for the traditional commodity groups. For example, in 2001, expenditures for diamonds made by seniors increased by 52% over 2000 (up $36.2 million) to reach $105.6 million, while such expenditures for precious metals decreased by 25.4% (down $30.8 million) to reach $90.5 million. Mine complex development expenditures decreased from $854.2 million in 1999 to $831.0 million in 2000. For 2001, expenditures stabilized at $829.5 million. In that year, precious metals expenditures decreased by $54.2 million while expenditures for diamonds increased by $64.6 million.

As a result of activity in the diamond sector, especially the development of the Diavik mine in the Northwest Territories, capital spending (construction, machinery and equipment), mostly incurred by senior companies, increased sharply from 1999 ($866.9 million) to 2000 ($1.5 billion). Capital spending increased again in 2001 to $1.8 billion.

In summary, total mineral resource development expenditures, including repair and maintenance costs, increased from $3.5 billion in 1999 to $4.2 billion in 2000 and to $4.6 billion in 2001. For diamonds alone, close to $900 million was spent in 2001 (Table 5).

Low metal prices have also had an impact on the number of significant metal and non-metal producing mines operating in Canada. In 2000, six new mines opened but this was more than offset by 12 mine closures. In 2001, the divergence was even more pronounced: 15 closures versus only 2 openings (for additional information, refer to the chapter on "Canadian Mine Openings, Closings, Expansions, Extensions and New Mine Developments"). Similarly, the number of advanced projects (at the deposit appraisal stage) are in decline, dropping from 132 in 1999 to 124 in 2000, 91 in 2001, and an expected 70 in 2002. The total number of advanced projects managed by seniors alone dropped from 33 to 24 between 2000 and 2001, resulting in a 25% decline in the associated expenditures. Generally, seniors manage one third of the advanced projects and account for 80% of such expenditures. Preliminary indications for 2002 are that there will be an improvement in the ratio of mine openings to closings. The effects of mine closings and cutbacks tend also to influence on-mine-site exploration expenditures and deposit appraisal expenditures. Between 1998 and 2001, expenditures dropped from $129.4 million to $71.5 million. For 2002, both on-mine-site exploration and on-mine-site deposit appraisal expenditures for senior companies are expected to rise in tandem with an expected improvement in mine opening and closing results. This increase, however, will likely be more than offset by declines in off-mine-site expenditures by senior companies. Mergers and changes in corporate strategy may continue to have an effect on their off-mine-site budgets as senior companies concentrate their efforts on producing operations.

Canadian companies remain committed to explore and develop properties in other countries. Indeed, more than 70% of recent budgets of the larger Canadian-based companies have been committed to programs abroad, although budgets have recently been declining there as well. Nevertheless, in global terms, Canada remains an attractive area for exploration (for additional information, refer to the chapter entitled "Canada's Global Mining Presence"). Since 1992, Canada has been second in the world as a recipient of exploration expenditures and, in fact, the difference between Canada and first-place Australia is narrowing (for additional information, refer to the chapter entitled "Canadian Mineral Exploration and Discovery Analysis").

NEW MEASURES FOR THE INDUSTRY

Metal market conditions are beyond government control as they are subject to global supply and demand dynamics. However, both the federal and several provincial and territorial governments have recently instituted measures designed to stimulate exploration in Canada. In addition to initiatives that were in place prior to 2000, the following recent initiatives, designed to stimulate exploration activity, are worth noting.

In the Economic Statement and Budget Update of October 18, 2000, the Minister of Finance announced a temporary 15% investment tax credit for investors in flow-through shares (FTS) of mineral exploration companies. This Investment Tax Credit for Exploration (ITCE) is designed to assist junior mining companies in raising new equity through the issuance of FTS and applies to eligible expenses incurred after October 17, 2000, and before January 1, 2004.

Following the introduction of the federal ITCE, harmonized tax credit programs were announced by Ontario in December 2000, Saskatchewan in March 2001, and British Columbia in July 2001.

In September 2001, the Quebec government announced the extension of its existing enhanced deduction program for FTS until the end of 2003.

In November 2001, the Yukon government announced that the Yukon Mineral Exploration Tax Credit had been extended until April 1, 2003. The tax credit was implemented on April 1, 1999, to encourage mineral exploration in the Yukon.

Finally, as part of its April 2002 budget, the Manitoba government introduced the Manitoba Mineral Exploration Tax Credit (MMETC).

For more information on taxation in the mining industry, refer to the Economic and Financial Analysis Branch (of Natural Resources Canada's Minerals and Metals Sector) web site at www.nrcan.gc.ca/miningtax/index.htm.

Provincially (Tables 15a and 15b), junior exploration and deposit appraisal expenditures increased between 2000 and 2001 in Ontario (up $12.7 million to $39.7 million), Nunavut (up $7.5 million to $40.1 million), and Quebec (up $5.3 million to $30.0 million). Smaller increases were registered in New Brunswick, Manitoba and the Northwest Territories. British Columbia's junior exploration expenditures remained virtually unchanged at $18.3 million. Expenditures in the other provinces and territories declined from 2000 to 2001. Referring again to junior companies, but for off-mine-site exploration only, increased expenditures are anticipated everywhere except for Nova Scotia, Saskatchewan and the Northwest Territories in 2002, compared to 2000. The decline is expected to be lower than $1 million for each of Nova Scotia and Saskatchewan.

MINERAL RESOURCE DEVELOPMENT EXPENDITURES, 2001

The wide spectrum of mineral resource development activities and their geographic dispersion across Canada require detailed and sophisticated indicators to measure activity levels. The information collected since 1997 by mineral resource development work phase permits a more complete monitoring of the activities of an exploration project as it progresses toward the mine complex development stage (Table 20).

Mineral Exploration

Of the $1.3 billion in mineral resource development expenditures in 2000 and 2001 (excluding capital, repair and maintenance expenditures), the mineral exploration phase (which includes activities up to and including the first delineation of a previously unknown mineral deposit to establish its potential economic value [tonnage and grade]), accounted for $381.2 million (28.4% of the total) in 2001 compared to $342.5 million (25.8%) in 2000 (Tables 1, 9a and 16a). Although exploration was on the rise, decreases (totaling $10.8 million) were recorded in New Brunswick, Nova Scotia, Alberta, Manitoba, British Columbia, and the Yukon, and were not significant for Saskatchewan. The exploration total for 2001 represents 74.3% of all exploration and deposit appraisal expenditures, compared to 69.0% in 2000. In 2001, some 88.9% of spending in the mineral exploration phase was at off-mine-site locations, down slightly from 91.0% in 2000. Junior companies spent $157.9 million in 2001 on exploration at off-mine-site locations (Table 3c) while seniors spent $181.0 million. For the juniors, exploration expenditures incurred at off-mine-site locations have increased by 69.9% ($65.0 million) since 1999.

The significant increase in off-mine-site exploration expenditures between 2000 and 2001 ($27 million) had an impact on overall exploration and deposit appraisal expenditures and explains, in large measure, the increase in the exploration share of total expenditures (74.3%, compared to 69.0% in 2000). Most of the increases (Tables 7a, 7b, 15a and 15b) came from Nunavut (up $14.6 million) and Ontario (up $22.6 million). In Nunavut (Figure 7a), two juniors increased their budgets significantly: Hope Bay Gold Corporation Inc. at the Hope Bay gold project and Twin Mining Corporation at the Jackson Inlet project, which had an impact on precious metal and diamond expenditures, respectively. Similarly, in Ontario, two seniors increased their budgets significantly: De Beers Canada Exploration Inc., at and around the Victor project, and Goldcorp Inc., at the former Cochenour mine, thus affecting diamond and precious metal expenditures, respectively. On-mine-site exploration is also on the rise after a low of $30.7 million in 2000, partly as the result of an important exploration program at the Raglan mine in Quebec by Société minière Raglan du Québec ltée. In 2001, a total of $42.3 million was expended on-mine-site in Canada.

In 2001, as in 2000, Ontario ranked first, followed by Quebec, in exploration expenditures. These two provinces accounted for close to half of the total exploration expenditures in 2001. In 1999, this ranking was reversed. In 2001, exploration expenditures exceeded deposit appraisal expenditures in all provinces and territories except Nova Scotia (nonmetals) and the Northwest Territories (diamonds) where deposit appraisal was the main target of expenditures (Figures 6a and 6b). As usual, off-mine-site exploration was dominant over on-mine-site exploration in all provinces and territories. In 2001, for off-mine-site exploration expenditures, Ontario, with $81 million, was by far the leader followed by Quebec and Nunavut with $59 million and $52 million, respectively. Quebec was first for on-mine-site exploration expenditures. In 2000, Quebec was first in off-mine-site exploration and second in on-mine-site exploration.

In decreasing order of exploration expenditures by commodity group, precious metals ranked first in 2001, followed by base metals and then diamonds (Tables 13a and 18a), accounting for $133.1 million, $114.1 million and $95.5 million, respectively. Exploration for diamonds in Ontario was at a record level due mainly to the Victor project of De Beers Canada Exploration Inc. (Figure 6a). The ranking of commodities sought for off-mine-site exploration was precious metals at $109.0 million, followed closely by base metals at $100.0 million and diamonds at $95.5 million; for on-mine-site exploration, precious metals were the leader at $24.1 million followed by base metals at $14.1 million. Looking at the dominant commodity groups in the provinces and territories, again in 2001 as in 2000, precious-metal exploration was dominant in Ontario, Nunavut (diamonds were dominant in 1999 but, recently, the major Hope Bay gold project has caused a change), British Columbia and the Yukon; base metals were dominant in Quebec (precious metals were dominant in 1999), Manitoba, Newfoundland and Labrador, and New Brunswick; uranium in Saskatchewan; diamonds in the Northwest Territories and Alberta; and nonmetals in Nova Scotia (Figure 6a).

Deposit Appraisal

For the deposit appraisal phase, which includes activities that bring a delineated deposit to the stage of detailed knowledge required for a production feasibility study, expenditures in 2001 totaled $131.7 million (25.7% of the total), down again from the $154.1 million (31.0%) spent in 2000 (Tables 1, 9b and 16b). Despite a decrease in deposit appraisal expenditures, increases were recorded in Newfoundland and Labrador, Nova Scotia, New Brunswick, Quebec and the Northwest Territories. The percentage of deposit appraisal expenditures spent on off-mine-site locations was 77.8% in 2001 and 72.6% in 2000. At off-mine-site locations (Table 3c), junior companies spent only $19.8 million on deposit appraisal activities in 2001 ($28.1 million in 2000), due in part to less advanced work being done on the Hope Bay gold project in Nunavut, while seniors spent $82.7 million (as opposed to $83.7 million in 2000).

In 2001, the Northwest Territories ranked first followed by Quebec and Ontario in terms of deposit appraisal expenditures (Tables 7b, 16a and 16b). Together these three jurisdictions accounted for about 68.6% of the total deposit appraisal expenditures. Deposit appraisal at off-mine-site locations (Tables 7a and 7b) was dominant everywhere except in Ontario, Manitoba and New Brunswick where deposit appraisal at on-mine-site locations ranked first, attributable to precious metals for Ontario and base metals for the latter. For deposit appraisal expenditures at off-mine-site properties, the Northwest Territories was a strong first in 2001 (in 2000, it ranked third), while Ontario ranked first for deposit appraisal at on-mine-site properties (in 2000, it ranked second after Quebec). The important increase in off-mine-site activities in the Northwest Territories, as a result of the two major diamond projects managed by De Beers Canada Mining Inc. and De Beers Canada Exploration Inc. (Snap Lake and Gahcho Kué), was partly offset by a much smaller budget allocated to the Victor project (which was on hold) in Ontario by the same company (De Beers Canada Exploration Inc.). Most of the decrease in deposit appraisal at on-mine-site locations was a consequence of an important decline in expenditures at the Raglan mine in Quebec.

In decreasing order of deposit appraisal expenditures by commodity group in 2001, diamonds were first followed by precious metals and then base metals (Tables 13b and 18b) with $49.2 million, $33.8 million and $25.3 million of the $131.7 million, respectively. When considering deposit appraisal at off-mine-site locations, the commodity grouping by rank is diamonds, first; base metals, second; and precious metals, third. For deposit appraisal at on-mine-site locations, precious metals is by far the dominant commodity group followed by base metals.

Looking at total deposit appraisal expenditures by dominant commodity group (Figures 6a and 6b) in the provinces and territories, the distribution is the same as for exploration except for Quebec, British Columbia and the Yukon. For these jurisdictions, precious metals led base metals for Quebec, and base metals led precious metals for British Columbia and the Yukon. In 2000, Newfoundland and Labrador and British Columbia had precious metals as the leading commodity group.

Mine Complex Development

Expenditures on the mine complex development phase, which includes activities to define, block out and gain access to the ore, prepare it for production, and other field work to extend the current ore reserves (excluding capital, repair and maintenance costs) were maintained at $830 million for the second year in a row (Table 1). By definition, all activities in the mine complex development phase are on-mine-site activities.

In 2001, as in 2000, Quebec was first, followed by Ontario, and together these two provinces accounted for 51.3% in 2001, and 64.8% in 2000, of all mine complex development expenditures (Tables 9d and 16d), while the Northwest Territories ranked third. Major mine complex development expenditures incurred by Diavik Diamond Mines Inc. at the Diavik mine, set to be in production in 2003, caused Quebec and Ontario's share to decrease in 2001. Precious metals, the main commodity group targeted, represented 27.5% of all expenditures for this work phase (Tables 13d and 18d), almost equivalent to that of base metals, while diamonds represented 14.8%.

Mineral Resource Development Activity by Work Phase

The distribution of expenditure by type of activity and by work phase reflects project evolution over time. Figure 4 shows graphically and quantitatively how the distribution of expenditures in the exploration work phase is different from those in the deposit appraisal work phase and the mine complex development phase. The distribution of the expenditures by work phase is somehow consistent through the years.

The exploration work phase is characterized mainly by surface drilling and geoscientific surveys that are used to discover a deposit and complete its first delineation. In the deposit appraisal work phase, the deposit is better defined by further surface and/or more underground drilling and, in many cases, by the beginning of important rock work. Ultimately, intense engineering studies are conducted and a feasibility study concludes this phase. If the feasibility study results are positive, a commitment to go into production is usually made. The mine complex development phase is characterized by large-scale (mainly underground) rock work, more underground drilling and large capital investment in order to build or extend the mine and its facilities.

For example, in 2001, geology accounted for 46.5% of the geoscientific survey expenditures during the exploration work phase as geochemistry and geophysics also play an important role in identifying and verifying mineral showings. Geology accounted for 81.9% of the geoscientific survey expenditures during the deposit appraisal work phase and for 75.7% during the mine complex development work phase.

As for the differences during the exploration work phase between activities taking place on-mine-site and off-mine-site, in 2001 there was generally more rock work, less geochemistry, and no airborne geophysics at on-mine-site locations while there are no records of underground drilling and there was a very small amount of rock work at off-mine-site locations. As for the differences between on-mine-site and off-mine-site activities during the deposit appraisal work phase, in the former there is more underground drilling and rock work while, in the latter case, there are more engineering studies.

TOTAL MINERAL RESOURCE DEVELOPMENT INVESTMENT, 2001

Total mineral resource development investment in Canada, including capital and repair and maintenance expenditures, increased by 11.3% from $4.2 billion in 2000 to $4.6 billion in 2001 (Table 1). Capital, and repair and maintenance expenditures include spending for construction, machinery and equipment. Most of these expenditures (99.6%) were directed at mine complex development in 2001. In that year, $1.8 billion was spent on capital investment while $1.5 billion was spent on repair and maintenance. Each represents about one third of the total mineral resource development investment. Compared to 2000, capital investment increased by 19.1% and repair and maintenance costs increased by 12.8%.

As shown in Figure 1b, Quebec, Ontario, the Northwest Territories and British Columbia represented 77.2% of all mineral resource development sented 77.2% of all mineral resource development investment in 2001. The highest level of capital investment was recorded in the Northwest Territories (30.4% of the total) which, when combined with Quebec and Ontario, represented 77.3% of all capital expenditures. In the Northwest Territories, capital expenditures exceeded those of other mineral resource development expenditures and were mainly the result of the Diavik diamond mine being developed. The smallest contribution of capital investment, compared to the other mineral resource development investment, for a single province or territory was recorded in Nova Scotia and Nunavut (apart from the Yukon where no expenditures were recorded).

In 2001, investment in the environment (included in the above total investment) accounted for 2.7% ($125.8 million) of all investment (Table 2). Quebec, Ontario and British Columbia spent the most on environment, accounting for 56.2% ($70.7 million) of all environment expenditures. In 2000, it is important to note that British Columbia ranked first with $25.8 million spent while Quebec ranked first in 2001 with $30.2 million.

MORE ABOUT MINERAL RESOURCE DEVELOPMENT ACTIVITIES, 2001

Traditional indicators of exploration activity also include new mineral claims acquired and the total number of metres drilled (Figure 3); however, expenditures on mineral exploration and deposit appraisal have proven to be the most accurate indicator of mineral exploration and deposit appraisal activity. Some results for the sum of exploration and deposit appraisal work phase expenditures are reviewed here.

New Mineral Claims

New mineral claims staked or recorded in Canada in 2001 covered an area of 11.2 million hectares (ha), compared to 10.3 million ha in 2000. Alberta, Quebec and Manitoba accounted for about 66.0% of the total staking activity during the year (Tables 6a and 6b). For the fifth year in a row, Alberta was the leading province with over 4 million ha staked, accounting for nearly 37.6% of total new mineral claim activity. However, this is still relatively low compared to the diamond claim staking that occurred in Alberta in 1997 when over 37 million ha were staked. Increases in 2001 staking were recorded in Alberta, Newfoundland and Labrador, Ontario and Saskatchewan.

In Alberta, much of the lands (claims dropped) were quickly reacquired by other parties. In Newfoundland and Labrador, the increase in the area staked can be attributable to an increase in exploration for nickel and platinum-palladium in Labrador, for gold in central Newfoundland, and for base metals in eastern Newfoundland. In Ontario, the increase is directly linked to more exploration for platinum group metals and diamonds. In Saskatchewan, a sustained interest in diamonds still has an impact on the level of new claims being staked in that province.

Drilling Activity for Exploration and Deposit Appraisal

Total exploration and deposit appraisal drilling (both diamond and other types) amounted to 1.8 million metres (m) in 2001 (Tables 16c and 10b), down from 2.1 million m in 2000. Of the 2001 total, diamond drilling accounted for 95.1%, or 1.7 million m. Surface exploration and deposit appraisal drilling totaled 1.4 million m, of which 95.2% was diamond drilling. Underground exploration and deposit appraisal drilling amounted to 0.37 million m of which 94.7% was diamond drilling. The statistics reveal that 30.1% of all metres drilled were for on-mine-site exploration and deposit appraisal.

In terms of regional activity in 2001, Quebec, Ontario, British Columbia and Manitoba, in decreasing order of importance, were the most active jurisdictions accounting for 75.2% of all drilling (surface and underground) (Table 16c).

Of the 1.4 million m drilled for surface exploration and deposit appraisal, 44.9% was undertaken mainly for precious metals, 35.5% for base metals, 7.8% for diamonds, 4.5% for uranium, and 3.3% for other metals. Ontario at 27.7%, Quebec at 23.8%, and British Columbia at 14.6% were the leading jurisdictions for surface metres drilled in Canada during 2001 (Table 17a).

Of the 0.37 million m drilled for underground exploration and deposit appraisal, precious metals activity accounted for 66.2% and base metals for 26.2%. Quebec accounted for 44.5% of total underground activity followed by Ontario with 28.1% (Table 17b).

On-Mine-Site and Off-Mine-Site Exploration and Deposit Appraisal Expenditures

Exploration and deposit appraisal expenditures for off-mine-site activity were $441.4 million in 2001, up from 423.6 million in 2000. On-mine-site activity totaled $71.5 million in 2001, down from $73.0 million in 2000 (Table 1).

As in 2000, Ontario ranked first with 19.6% of the total, followed closely by the Northwest Territories at 19.1% and Quebec at 16.8% (Quebec was second in 2000) of the total off-mine-site exploration and deposit appraisal spending in 2001 (Tables 7a and while Ontario accounted for 38.1% of the total on-mine-site spending. There was no on-mine-site spending reported in the Yukon.

Of the mineral commodities sought in 2001, diamonds accounted for 32.2% of off-mine-site expenditures followed by precious metals and base metals at 28.1% and 27.1%, respectively. On-mine-site expenditures on the search for precious metals amounted to 60.1% of the total while base metals accounted for 27.7% (Table 12b).

Exploration and Deposit Appraisal Activity by Province/Territory

Despite a 3.3% increase in total exploration and deposit appraisal expenditures, expenditures decreased in most provinces and territories except Newfoundland and Labrador, Quebec, Manitoba, and the Northwest Territories. A major increase of 68.7% in the Northwest Territories, mainly attributable to the Snap Lake diamond project of De Beers Canada Exploration Inc., offset all recorded decreases. Only Quebec and Ontario had expenditures in excess of $100 million. The three leading jurisdictions, in decreasing order of expenditures, were Ontario, Quebec and the Northwest Territories, which together accounted for 59.1% of Canada's total exploration and deposit appraisal expenditures during 2001. Significant declines (above 30%) in percentage terms occurred in Alberta and the Yukon but, in dollar terms, Saskatchewan and British Columbia together represented 50.2% ($14.8 million) of the total decrease of $29.6 million (Tables 8 and 9c).

Exploration and Deposit Appraisal Expenditures by Mineral Commodity Sought

Precious metals (including gold, silver and PGM), diamonds, and base metals (including copper, nickel, lead and zinc) continued to be the principal targets of exploration and deposit appraisal activities in Canada in 2001 (Tables 12a and 12b, and Figure 5).

Precious metals exploration and deposit appraisal expenditures declined by 13.8% to $166.9 million in 2001, down from $193.6 million in 2000. This type of expenditures represented only 32.5% of total Canadian expenditures in 2001, compared to 39.0% in 2000. Despite this decline, precious metals expenditures exceeded those for base metals, as has generally been the case with the exception of 1992 and the period prior to 1985. But, for the first time, diamonds became the second most sought commodity, surpassing base metals as explained below.

Ontario was the leading recipient of exploration and deposit appraisal expenditures for precious metals at 34.5% ($57.6 million) followed by Quebec at 25.6% ($42.8 million) (Tables 13c and 18c). The other leading jurisdictions were Nunavut at 18.1% and British Columbia at 8.7%. For all of these jurisdictions except Quebec, precious metals were the dominant commodity group searched for. It is also worth noting that PGM expenditures were still around $30 million (most of it in Ontario). All jurisdictions were down from 2000 spending levels for precious metals with the exception of New Brunswick and Manitoba (Figure 6c).

Diamond exploration and deposit appraisal expenditures increased to $144.7 million in 2001 from $91.9 million in 2000 (Table 12b). Spending on diamonds accounted for 28.2% of all exploration and deposit appraisal expenditures in Canada during 2001. As in recent years, the largest amount of exploration and deposit appraisal spending on diamonds in Canada, $78.9 million, or 54.5%, occurred in the Northwest Territories (Tables 13c and 18c, and Figure 6c). Second in ranking has been Nunavut but, in 2001, Ontario took over second place with $27.5 million (19.0%), followed now by Nunavut in third with $17.7 million (12.2%). In Ontario, although many companies are searching for diamonds (23 project operators), the De Beers' Victor project spurred activity in the province. Quebec, Saskatchewan, Manitoba and Alberta together accounted for the remaining 14.2% of all diamond exploration and deposit appraisal expenditures. Diamonds were the leading commodity sought in the Northwest Territories and Alberta, accounting for 91.1% and 56.9% respectively of their total exploration and deposit appraisal spending.

Base metals dropped to the third most sought-after commodity grouping in 2001. Base-metal exploration and deposit appraisal expenditures fell by 5.8% to $139.4 million in 2001 from $148.0 million in 2000. Prior to this, especially in 1996, buoyant base-metal exploration and deposit appraisal can be mostly attributed to the overall impact of the late-1994 major nickel-copper discovery at Voisey's Bay in Labrador. Base-metal activities accounted for 27.2% of total Canadian exploration and deposit appraisal expenditures in 2001.

In 2001, Quebec was the leading recipient of base-metal exploration and deposit appraisal expenditures at 34.2% of the total ($47.7 million) (Table 18c and Figure 6c). Other leading jurisdictions were Ontario at 17.1% ($23.8 million), Manitoba at 12.4% ($17.3 million), and Newfoundland and Labrador at 11.3% ($15.8 million). For Newfoundland and Labrador, New Brunswick, Quebec and Manitoba, base metals were the main commodity group for which exploration and deposit appraisal were conducted.

All other mineral commodities accounted for $61.8 million (12.1%) of exploration and deposit appraisal expenditures in Canada during 2001. This was comparable to the 2000 results. They consist of uranium at 43.8%, other metals at 29.9%, nonmetals at 13.8%, coal at 8.9%, and iron at 3.6%. Most of the uranium expenditures were reported in Saskatchewan where uranium is the leading commodity sought. Worth mentioning are significant expenditure increases for the following additional metals: vanadium, tantalum and rare earth elements. Altogether they contributed 35.9% ($6.6 million) in 2001, compared to 11.6% ($2.1 million) in 2000, of all expenditures in that category. The nonmetals category (excluding diamonds) totaled $8.5 million, of which, in decreasing order of expenditures, stone, graphite, kaolin and gemstones contributed close to 50% of all expenditures in this category. British Columbia, Nova Scotia and Quebec represented 66.9% of all nonmetals expenditures. Nonmetals remain the leading commodity group in Nova Scotia. Coal is primarily reported in British Columbia and Alberta and remained the second most sought-after commodity in Alberta for the fourth consecutive year.

Exploration and Deposit Appraisal by Range of Expenditures and by Junior and Senior Companies

Companies active in exploration and deposit appraisal in Canada are originally classified into six groups: (1) producers, (2) affiliates of producing mining companies, (3) oil companies, (4) foreign companies, excluding oil companies, (5) junior companies and prospectors, and (6) other companies. A company is classified into the first of these groups in which it fits. Table 19 lists expenditures for each group. For this analysis, companies classed in groups 1, 2, 3, 4 and 6 are referred to as seniors.

Of the 515 active company project operators (excluding prospectors) in 2001, 78 (spending more than $1 million each) accounted for 83.3% of the total exploration and deposit appraisal expenditures of $512.9 million (including prospectors) (Table 4). This compares to 86 project operators accounting for 84.0% in 2000. In 2001, 39 of these were senior companies (50 in 2000) representing 62.6% ($321.3 million) of all Canadian expenditures, compared to 65.8% ($327.0 million) in 2000; 39 were junior companies (36 in 2000), representing 20.6% ($105.7 million), compared to 18.2% ($90.4 million) in 2000. About 60% of the junior expenditures occurred in the expenditure ranges above $1 million, compared to 96% for the seniors in the same expenditure ranges.

During 2001, there were more junior project operators in the $5 million-$10 million expenditure range than in 2000, leading to increased spending in these categories. As in 2000, only one junior company spent more than $10 million in 2001. A major increase (of 14) in the number of junior project operators was in the $100 000-$200 000 range of expenditures, but they only had a very small impact on the overall junior spending in that range (up $2.1 million). About one third of junior project operators (122) spend in the $1-$50 000 range of expenditures but contribute only about 1% of all junior spending.

For the seniors, there were more companies spending above $10 million (three more project operators for an increase of $62.2 million), but this increase was counterbalanced by fewer project operators (28 instead of 42) in the $1 million-$5 million and $5 million-$10 million ranges, for a total decrease of $67.9 million in those groups. The majority of senior project operators spent in the $100 000-$200 000 range of expenditures but represent only 1.1% of all senior expenditures. In 2000, the $1 million-$5 million range was dominant. There is also a significant number of senior project operators in the $1-$50 000 range of expenditures (25), representing less than 0.1% of the senior expenditures.

Exploration and Deposit Appraisal Expenditures by Junior and Senior Companies

Expenditures incurred by junior companies in 2001 increased by 14% to reach $177.7 million (Tables 14b and 15b). In 2002, expectations are for a further increase of 17.8%. In 2001, increases were recorded in New Brunswick, Quebec, Ontario, Manitoba, the Northwest Territories and Nunavut. In dollar terms, increases were very important in Ontario, Nunavut and Quebec (up $25.4 million). Altogether, in decreasing order of importance, Nunavut, Ontario, Quebec and British Columbia accounted for 72.1% of all junior expenditures (Figure 7c). Over the 1999-2002 period, the share of the junior expenditures increased from 28.0% to 31.4% to 34.7% to 41.8% in 2002, based on spending intentions.

Expenditures reported by senior companies decreased slightly by 1.6% in 2001. In 2002, a further decline of 12.9% is yet to be confirmed. In 2001, decreases were recorded in New Brunswick, Ontario, Manitoba, Saskatchewan, Alberta, British Columbia, the Yukon and Nunavut. In dollar terms, important declines were reported in Ontario, Nunavut and British Columbia (in total a drop of $31.7 million), but were compensated for by an important increase in the Northwest Territories (up $33.3 million). Altogether, in decreasing order of importance, Ontario, Quebec, the Northwest Territories and Saskatchewan accounted for 74.2% of all senior expenditures (Figure 7c).

In 2001, as in 2000, junior companies principally spent, in the same order of importance, for precious metals (43.0%), base metals (24.9%) and diamonds (22.0%). Of the $76.4 million spent on precious metals, about $23 million was dedicated to platinum group metals. As for the seniors, the primary target was diamonds (31.5%), followed by base metals (28.4%) and precious metals (27.0%). In 2000, the main target for the seniors was precious metals (35.6%), followed by base metals (30.5%) and diamonds (20.4%) (Figure 8c).

CONCLUSION

In conclusion, it is encouraging that the levels of exploration and deposit appraisal in Canada for 1999, 2000 and 2001 have at least been maintained around $500 million after the recent declines recorded in 1997 and 1998. Further improvements in the levels are still to be confirmed and will appear in the final 2002 results. The impact of the incentive measures put in place since 2000 by different governments has not yet been fully assessed, but junior company expenditures for off-mine-site activities appear to be on the rise. Moreover, overall mineral resource development in Canada remains dependent on global economic conditions and the investment climate, and the directions of both these factors were unclear and uncertain at mid-year 2002.

Diamonds continue to be an important player in terms of total mineral resource development expenditures. Capital costs, and consequently total mineral investment, increased in 2001, reaching $4.6 billion. A second diamond mine, Diavik, is scheduled to open in 2003. Other promising projects are those by De Beers at Snap Lake in the Northwest Territories and the Victor project in Ontario, and by Tahera Corporation, which owns the Jericho project in Nunavut.

BACKGROUND INFORMATION ON MINERAL RESOURCE DEVELOPMENT STATISTICS

Natural Resources Canada (NRCan) coordinates the collection of all statistics for off-mine-site and on-mine-site expenditures for the exploration and deposit appraisal phases and the mine complex development phase. Statistics Canada coordinates the collection of detailed on-mine-site statistics on capital, repair and maintenance expenditures reported by producers at the mine complex development phase. NRCan and Statistics Canada cooperate with the provinces and territories to collect, assemble and publish the comprehensive national mineral resource development statistics presented in this review. These are compiled from the annual federal-provincial-territorial Survey of Mineral Exploration, Deposit Appraisal and Mine Complex Development Expenditures. To protect the confidential data provided by respondents, only aggregate statistics are released.

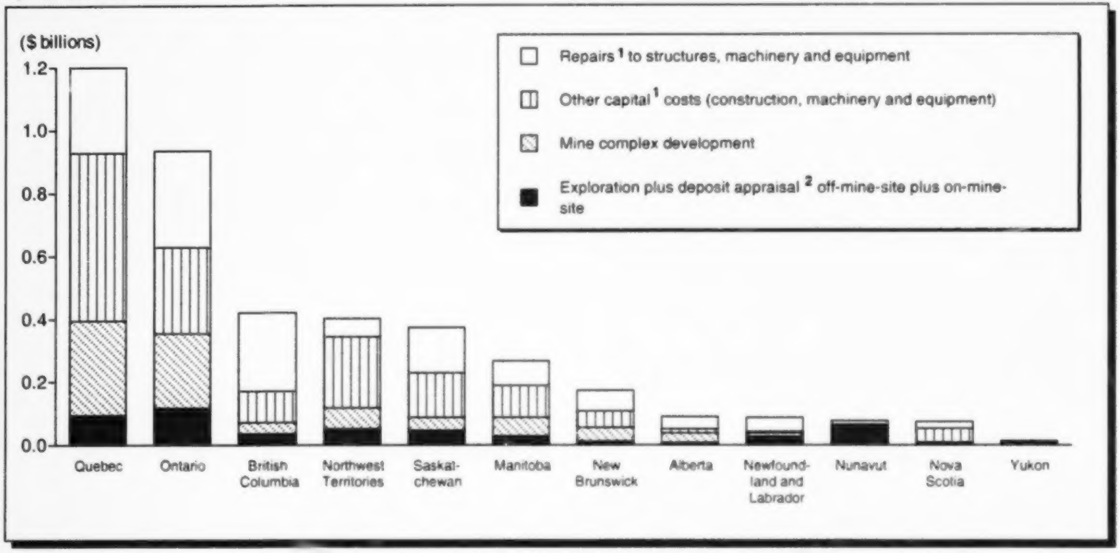
New definitions of work phases for mineral resource development were introduced in the 1997 survey. They provide a more complete and accurate coverage of mineral resource development expenditures in Canada from exploration to mine production. Table 20 describes the mineral resource development and mining process model upon which the new definitions are based. Specific definitions by category of expenditures are available on NRCan's exploration web site at http://mmsd1.mms.nrcan.gc.ca/mmsd/exploration/default_e.asp.

Notes: (1) Information in this review was current as of August 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

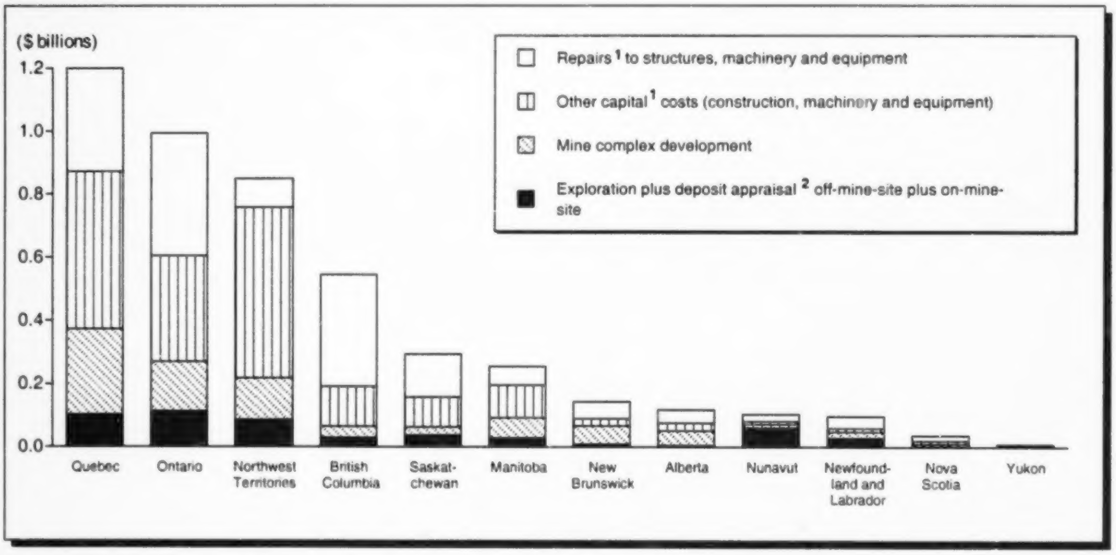
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 1a
Total Mineral Resource Development Expenditures in Canada, by Province and Territory, 2000
$4.2 Billion



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes expenditures related to exploration, deposit appraisal and mine complex development (97.5%). [2] Exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves.

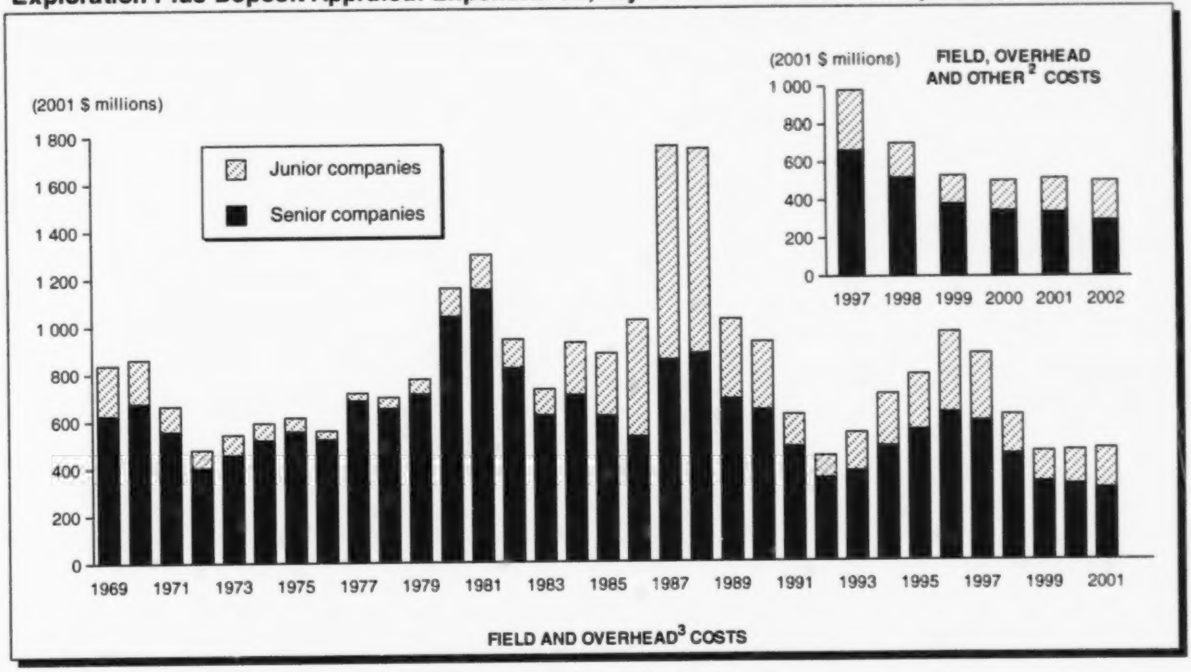
Figure 1b
Total Mineral Resource Development Expenditures in Canada, by Province and Territory, 2001
$4.6 Billion



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes expenditures related to exploration, deposit appraisal and mine complex development (99.6%). [2] Exploration and deposit appraisal activities include only the search for and appraisal of deposits and do not include work for extensions of known reserves.

Figure 2

Exploration Plus Deposit Appraisal Expenditures,[1] by Junior and Senior Companies, 1969-2002



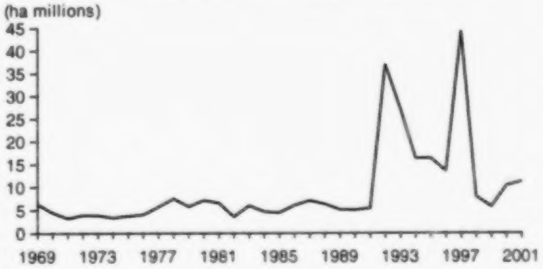
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. [2] Other costs include engineering, economic and pre- or production feasibility studies, environment, and land access. [3] Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures.

Notes: Total exploration expenditures for 1975-81 are overstated by an average of about 17% relative to earlier and later years because of changes to the methodology used by Statistics Canada over the years. Expenditures for 1997 to 2002 include both exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking). Data for 2002 (field, overhead and other costs only) are company spending intentions, revised August 21, 2002.

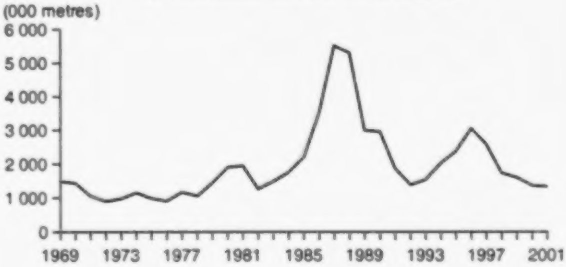
Figure 3
Selected Measures of Exploration Activity

Area of New Mineral Claims Staked or Recorded, 1969-2001



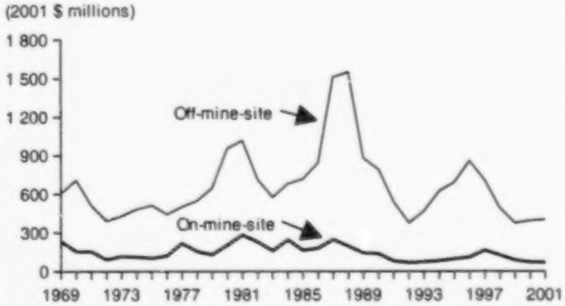
Source: Information obtained and compiled annually by Natural Resources Canada from provincial and territorial mining recorders.

Surface Diamond Drilling, 1969-2001
(all minerals except oil and gas)



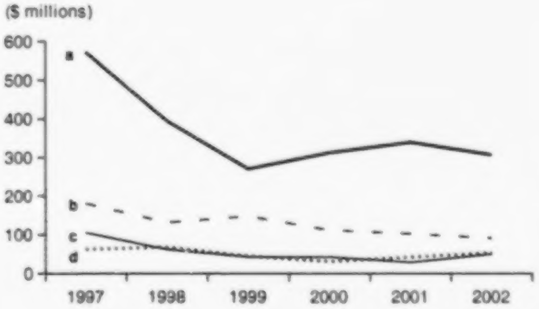
Sources: 1969-84, Statistics Canada (cat. no. 26-201); 1985-99, from a federal-provincial-territorial survey of mining and exploration companies.
Note: Drilling statistics for 1969-84 are not strictly comparable to and may be understated relative to those for 1985-99.

Exploration Plus Deposit Appraisal, Field Work Plus Overhead Expenditures, 1969-2001
(all minerals except oil and gas)



Sources: 1969-84, Statistics Canada, *Exploration, Development and Capital Expenditures for Petroleum and Natural Gas Wells, Intentions* (cat. no. 61-216); 1985-99, from a federal-provincial-territorial survey of mining and exploration companies.
Notes: Adjusted to 2001 dollars using Gross Domestic Product deflator series. These expenditures do not include expenditures for oil and gas exploration. Expenditures for 1997-2001 include exploration plus deposit appraisal as per new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). Off-mine-site and on-mine-site overhead expenditures for 1969-88 were estimated based on an average from the years 1989-96.

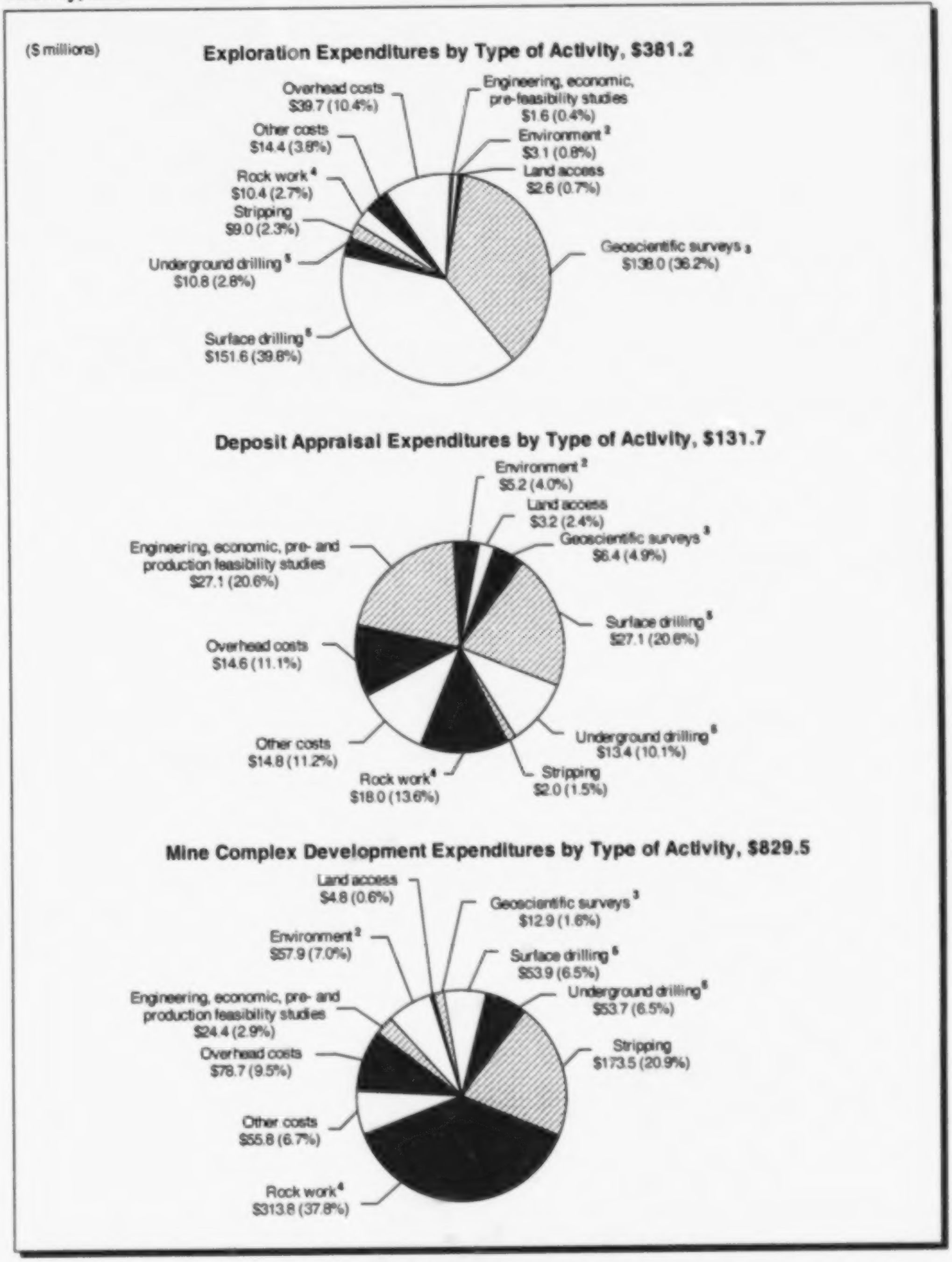
Exploration and Deposit Appraisal Expenditures,[1] On- and Off-Mine-Site, 1997-2002



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[a] Exploration, off-mine-site. [b] Deposit appraisal, off-mine-site. [c] Deposit appraisal, on-mine-site. [d] Exploration, on-mine-site.
[1] Includes field work, overhead, engineering, economic, pre- or production feasibility studies, environment and land access expenditures.
Note: Data for 2002 are company spending intentions, revised August 21, 2002.

Figure 4

Exploration, Deposit Appraisal and Mine Complex Development Expenditures,[1] by Type of Activity, 2001

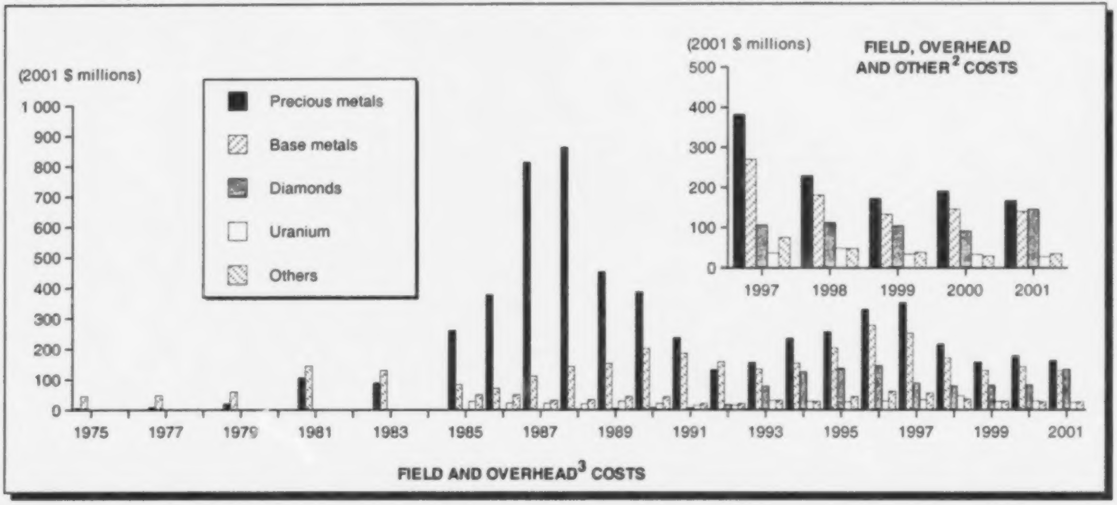


Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. [2] Environment includes characterization, permitting, protection, monitoring and restoration. [3] Geoscientific surveys include geology, geochemistry, ground geophysics and airborne geophysics. [4] Rock work activity includes shaft work, drifts, cross-cuts, raises, declines, rock sampling and dewatering costs. [5] Drilling includes diamond and other types of drilling.

Figure 5

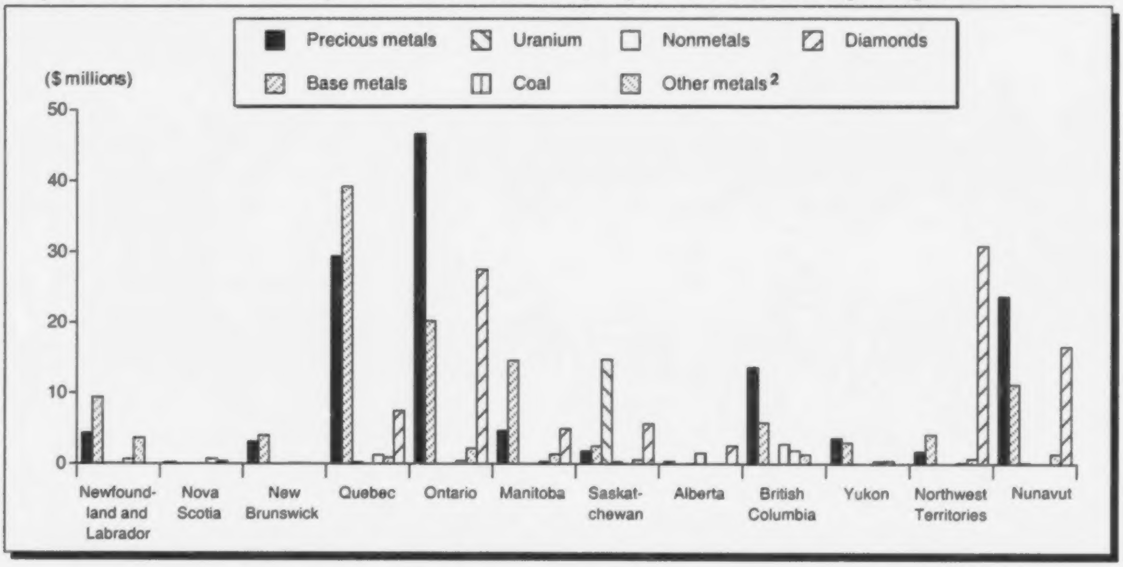
Exploration Plus Deposit Appraisal Expenditures,[1] for Base Metals, Precious Metals and Diamonds, 1975-2001



Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off mine-site activities; 1997-2001 expenditures include both exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were under exploration (broadly speaking). [2] Other costs include engineering, economic and pre- or production feasibility studies, environment, and land access. [3] Overhead costs include mineral leases, claims and property taxes, and project-related head office expenditures.
Note: Data have not been compiled for 1976, 1978, 1980, 1982 and 1984.

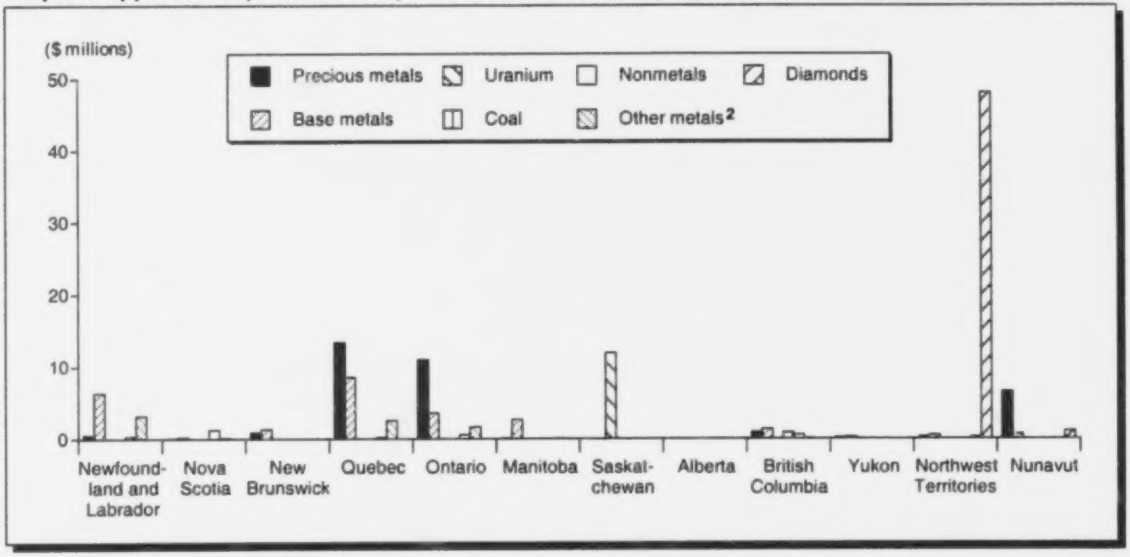
Figure 6a

Exploration Expenditures[1] by Province and Territory, by Mineral Commodity Sought, 2001



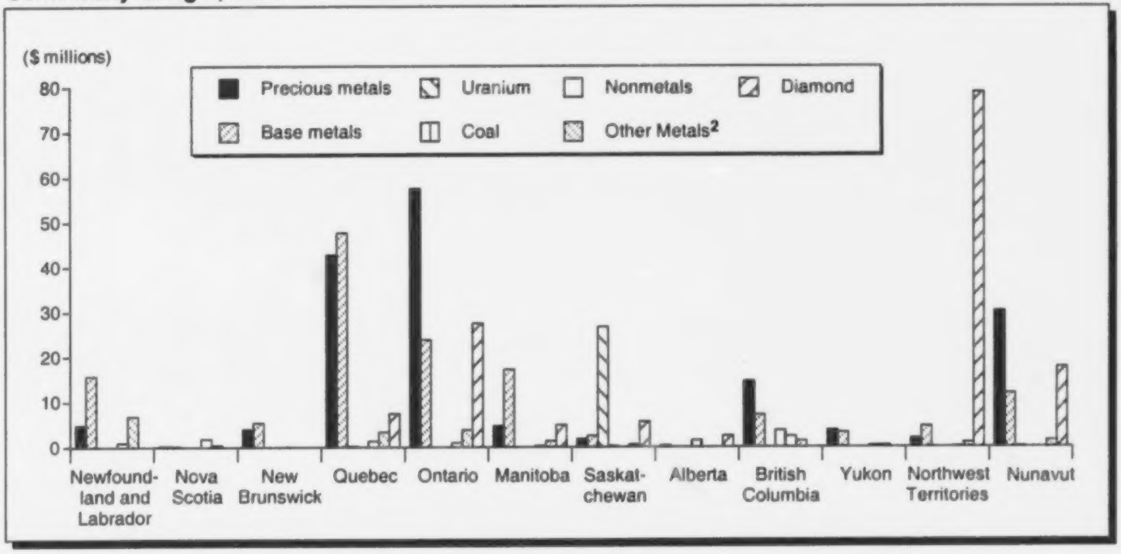
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 6b
Deposit Appraisal Expenditures[1] by Province and Territory, by Mineral Commodity Sought, 2001



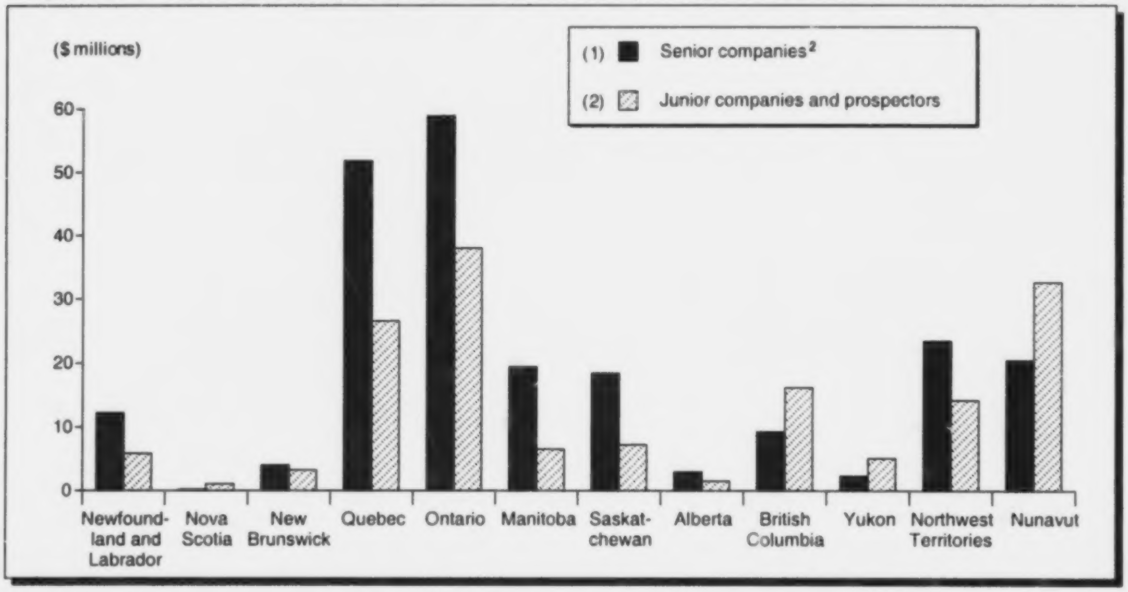
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 6c
Exploration Plus Deposit Appraisal Expenditures,[1] by Province and Territory, by Mineral Commodity Sought, 2001



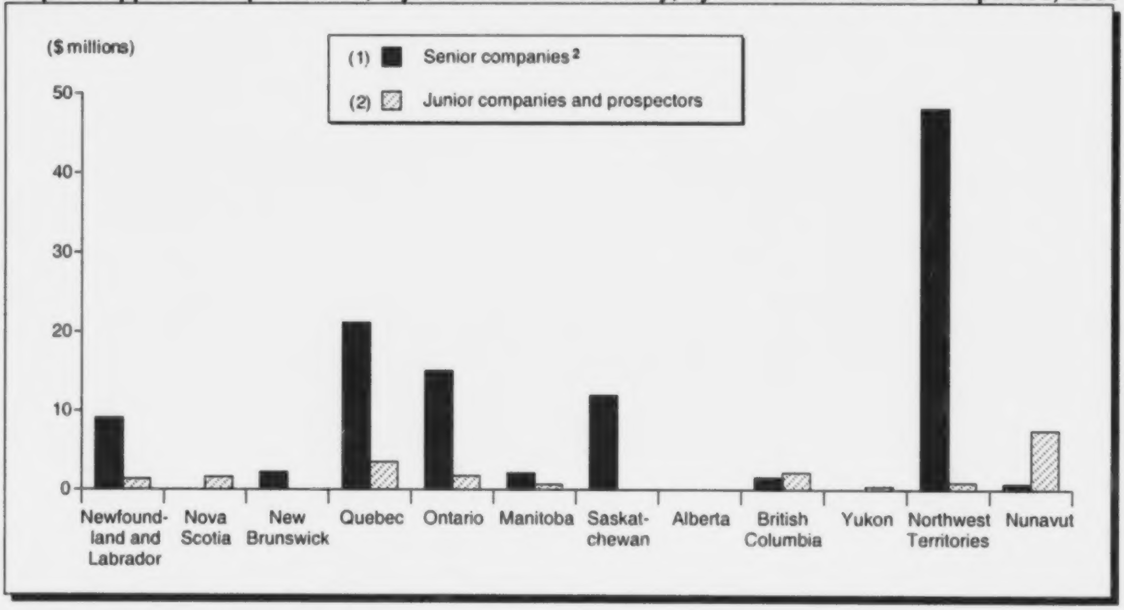
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Includes ferrous metals.

Figure 7a
Exploration Expenditures,[1] by Province and Territory, by Junior and Senior Companies, 2001



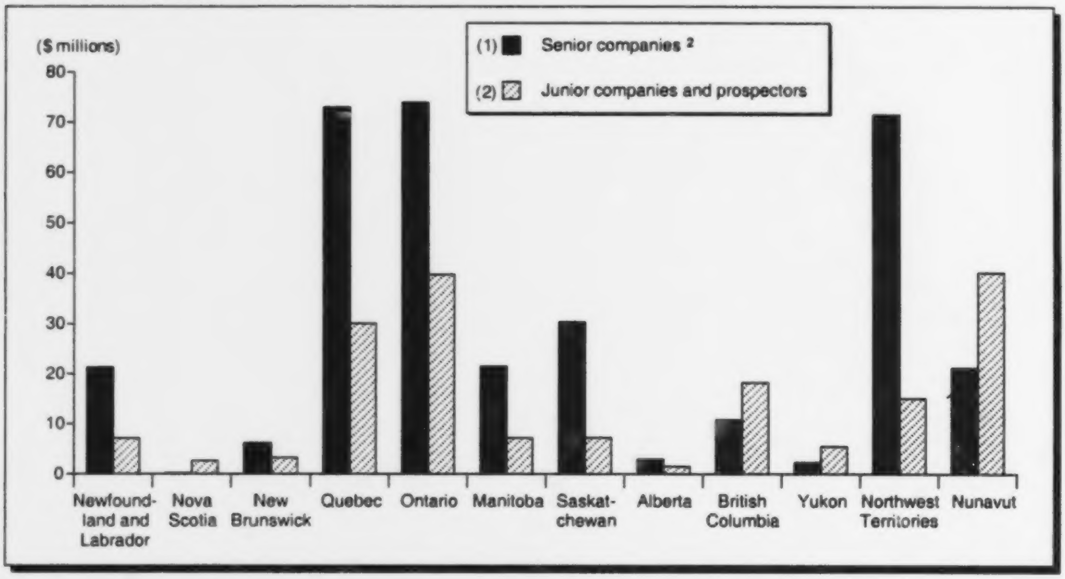
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies.

Figure 7b
Deposit Appraisal Expenditures,[1] by Province and Territory, by Junior and Senior Companies, 2001



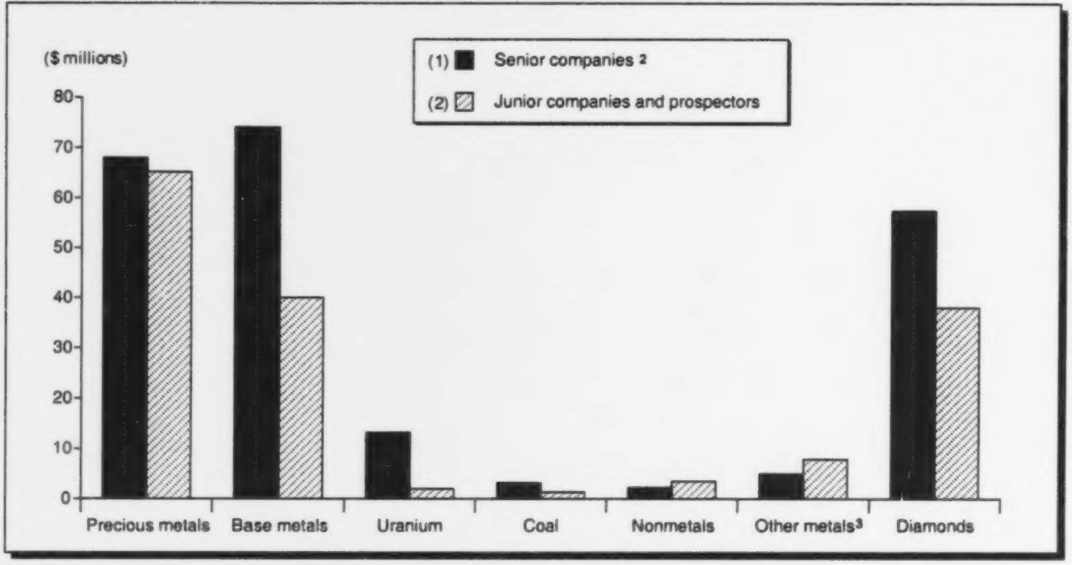
Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies.

Figure 7c
Exploration Plus Deposit Appraisal Expenditures,[1] by Province and Territory, by Junior and Senior Companies, 2001



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies.

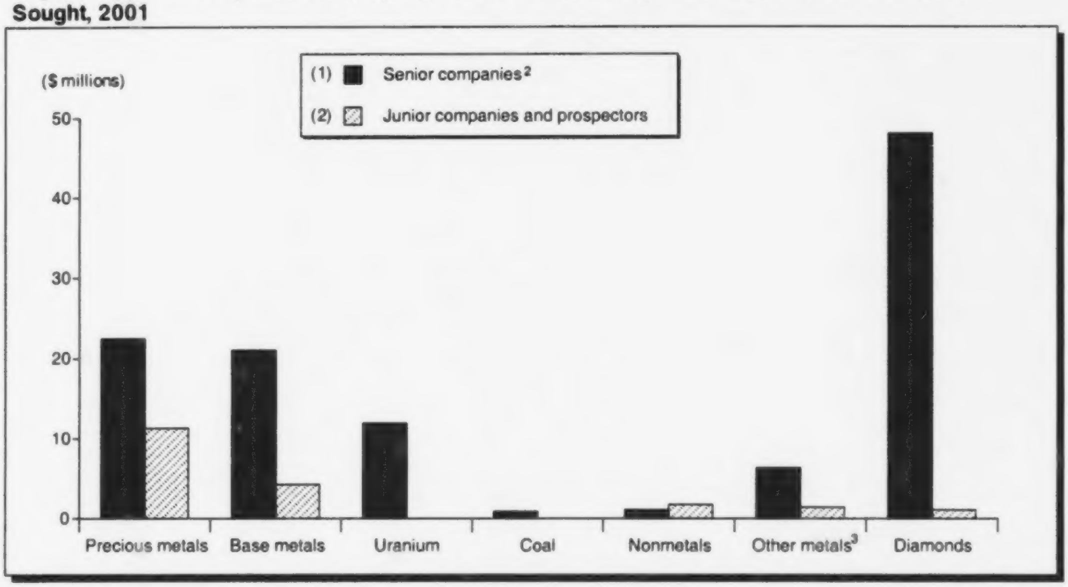
Figure 8a
Exploration Expenditures,[1] by Junior and Senior Companies and Mineral Commodity Sought, 2001



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies. [3] Includes ferrous metals.

Figure 8b

Deposit Appraisal Expenditures,[1] by Junior and Senior Companies and Mineral Commodity Sought, 2001

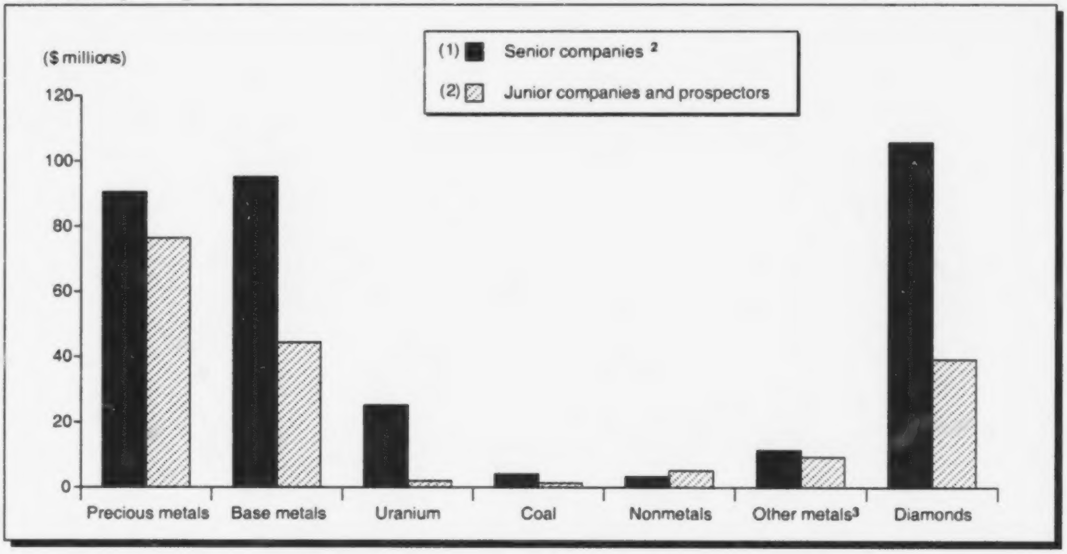


Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies. [3] Includes ferrous metals.

Figure 8c

Exploration Plus Deposit Appraisal Expenditures,[1] by Junior and Senior Companies and Mineral Commodity Sought, 2001



Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

[1] Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. [2] Senior companies include companies with a producing mine in Canada, affiliates of companies with a producing mine in Canada, oil companies, foreign companies (excluding oil companies), and other companies. [3] Includes ferrous metals.

TABLE 1. COMPARISON OF 2000 AND 2001 EXPENDITURES, ON- AND OFF-MINE-SITE ACTIVITY FOR EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT

Expenditure Category	2000					2001				
	Off-Mine-Site		On-Mine-Site		Total	Off-Mine-Site		On-Mine-Site		Total
	($ millions)	(%)	($ millions)	(%)	($ millions)	($ millions)	(%)	($ millions)	(%)	($ millions)
EXPLORATION										
Field work and overhead	301.9	91.2	29.3	8.8	331.2	332.2	88.9	41.6	11.1	373.9
Engineering studies	3.2	95.5	0.1	4.5	3.3	0.9	98.2	...	1.8	1.0
Economic studies	0.4	100.0	–	–	0.4	0.2	100.0	–	–	0.2
Pre-feasibility studies	1.7	59.8	1.1	40.2	2.8	0.3	59.7	0.2	40.3	0.5
Environment	2.0	92.1	0.2	7.9	2.2	2.7	86.5	0.4	13.5	3.1
Land access	2.6	99.4	...	0.6	2.6	2.6	98.9	...	1.1	2.6
Subtotal	311.8	91.0	30.7	9.0	342.5	338.9	88.9	42.3	11.1	381.2
Capital (1)	1.2	29.4	2.8	70.6	4.0	7.6	100.0	–	–	7.6
Repair and maintenance (1)	1.3	20.2	5.0	79.8	6.3	1.2	71.5	0.5	28.5	1.7
Total	314.2	89.1	38.6	10.9	352.9	347.6	89.0	42.8	11.0	390.4
DEPOSIT APPRAISAL										
Field work and overhead	86.2	68.0	40.6	32.0	126.9	69.6	72.4	26.6	27.6	96.2
Engineering studies	9.1	90.7	0.9	9.3	10.0	15.9	89.7	1.8	10.3	17.7
Economic studies	0.3	81.0	0.1	19.0	0.3	4.7	96.6	0.2	3.4	4.8
Pre- or production feasibility studies	7.4	96.3	0.3	3.7	7.7	4.3	94.2	0.3	5.8	4.6
Environment	7.2	95.8	0.3	4.2	7.6	4.9	93.5	0.3	6.5	5.2
Land access	1.6	97.5	...	2.5	1.7	3.2	100.0	–	–	3.2
Subtotal	111.9	72.6	42.3	27.4	154.1	102.5	77.8	29.2	22.2	131.7
Capital (1)	31.4	95.9	1.3	4.1	32.7	1.6	85.2	0.3	14.8	1.9
Repair and maintenance (1)	12.9	66.8	6.4	33.2	19.3	2.1	100.0	–	–	2.1
Total	156.1	75.7	50.0	24.3	206.2	106.2	78.3	29.5	21.7	135.7
EXPLORATION PLUS DEPOSIT APPRAISAL										
Field work and overhead	388.2	84.7	69.9	15.3	458.1	401.8	85.5	68.2	14.5	470.1
Engineering studies	12.2	91.9	1.1	8.1	13.3	16.8	90.1	1.8	9.9	18.7
Economic studies	0.7	91.2	0.1	8.8	0.7	4.8	96.7	0.2	3.3	5.0
Pre- or production feasibility studies	9.1	86.5	1.4	13.5	10.5	4.6	91.0	0.5	9.0	5.0
Environment	9.2	95.0	0.5	5.0	9.7	7.6	90.9	0.8	9.1	8.3
Land access	4.2	98.7	0.1	1.3	4.3	5.8	99.5	...	0.5	5.8
Subtotal	423.6	85.3	73.0	14.7	496.7	441.4	86.1	71.5	13.9	512.9
Capital (1)	32.6	88.6	4.2	11.4	36.7	9.2	97.0	0.3	3.0	9.5
Repair and maintenance (1)	14.2	55.3	11.5	44.7	25.6	3.3	87.4	0.5	12.6	3.7
Total	470.4	84.1	88.7	15.9	559.0	453.9	86.3	72.2	13.7	526.1
MINE COMPLEX DEVELOPMENT										
Field work and overhead	n.a.	n.a.	730.3	100.0	730.3	n.a.	n.a.	742.4	100.0	742.4
Engineering studies	n.a.	n.a.	50.5	100.0	50.5	n.a.	n.a.	23.4	100.0	23.4
Economic studies	n.a.	n.a.	7.1	100.0	7.1	n.a.	n.a.	0.1	100.0	0.1
Pre- or production feasibility studies	n.a.	n.a.	0.2	100.0	0.2	n.a.	n.a.	0.9	100.0	0.9
Environment	n.a.	n.a.	32.9	100.0	32.9	n.a.	n.a.	57.9	100.0	57.9
Land access	n.a.	n.a.	10.1	100.0	10.1	n.a.	n.a.	4.8	100.0	4.8
Subtotal	n.a.	n.a.	831.0	100.0	831.0	n.a.	n.a.	829.5	100.0	829.5
Capital (1)	n.a.	n.a.	1 454.0	100.0	1 454.0	n.a.	n.a.	1 766.1	100.0	1 766.1
Repair and maintenance (1)	n.a.	n.a.	1 329.0	100.0	1 329.0	n.a.	n.a.	1 524.0	100.0	1 524.0
Total	n.a.	n.a.	3 614.0	100.0	3 614.0	n.a.	n.a.	4 119.5	100.0	4 119.5
Grand total	470.4	11.3	3 702.7	88.7	4 173.1	453.9	9.8	4 191.7	90.2	4 645.6

Sources: Natural Resources Canada and Statistics Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.

(1) Includes construction, and machinery and equipment expenditures, as well as related environmental protection and restoration expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 2. SUMMARY OF ENVIRONMENT EXPENDITURES FOR EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT, 2000 AND 2001

Expenditure Category	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal				Mine Complex Development				Total			
	2000		2001		2000		2001		2000		2001		2000		2001		2000		2001	
	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)	($000)	(%)
Environment																				
Characterization	442	8.5	491	15.7	4 394	48.7	1 990	38.2	4 836	34.1	2 481	29.8	2 077	2.1	4 372	3.7	6 912	6.2	6 853	5.4
Permits	725	14.0	337	10.8	1 706	18.9	2 080	40.0	2 431	17.1	2 417	29.0	1 935	2.0	2 374	2.0	4 367	3.9	4 791	3.8
Protection	243	4.7	251	8.0	1 192	13.2	1 104	21.2	1 435	10.1	1 356	16.3	26 490	27.3	25 311	21.6	27 925	25.1	26 667	21.2
Restoration	746	14.4	2 055	65.6	275	3.0	30	0.6	1 021	7.2	2 085	25.0	2 383	2.5	25 814	22.0	3 404	3.1	27 899	22.2
Subtotal	2 156		3 134		7 567		5 204		9 723		8 338		32 885		57 872		42 608		66 210	
Capital, share of environment	128	2.5	–	–	–	–	–	–	128	0.9	–	–	32 207	33.1	26 324	22.4	32 335	29.0	26 324	20.9
Repair and maintenance, share of environment	2 882	55.8	–	–	1 460	16.2	–	–	4 341	30.6	–	–	32 099	33.0	33 239	28.3	36 440	32.7	33 239	26.4
Total environment	5 166	100.0	3 134	100.0	9 027	100.0	5 204	100.0	14 193	100.0	8 338	100.0	97 191	100.0	117 434	100.0	111 384	100.0	125 773	100.0
Total environment as a percentage of grand total (1)		1.5		0.8		4.4		3.8		2.5		1.6		2.7		2.9		2.7		2.7

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil.

(1) Grand total refers to Table 1.

Note: Numbers may not add to totals due to rounding.

TABLE 3a. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES, FIELD WORK PLUS OVERHEAD, BY JUNIOR AND SENIOR COMPANIES, 1969-2001

	Current Dollars				Constant 2001 Dollars			
	Share of Total			% of Total	Share of Total			% of Total
Year	Junior	Senior	Total	Junior	Junior	Senior	Total	Junior
	($ millions)				($ millions)			
1969	44.4	130.5	174.9	25.4	212.6	624.9	837.5	25.4
1970	39.9	147.2	187.1	21.3	183.6	677.4	861.0	21.3
1971	24.5	127.5	152.0	16.1	107.2	557.7	664.9	16.1
1972	18.3	97.4	115.7	15.8	75.7	402.9	478.6	15.8
1973	22.5	121.6	144.1	15.6	84.8	458.4	543.2	15.6
1974	21.8	158.5	180.3	12.1	71.5	520.0	591.5	12.1
1975	19.5	187.8	207.3	9.4	57.7	556.1	613.8	9.4
1976	13.9	192.9	206.8	6.7	37.6	521.8	559.4	6.7
1977	12.5	271.0	283.5	4.4	31.6	685.9	717.5	4.4
1978	19.8	275.0	294.8	6.7	47.0	652.5	699.5	6.7
1979	29.4	329.5	358.9	8.2	63.5	711.9	775.4	8.2
1980	60.2	530.0	590.2	10.2	118.1	1 039.5	1 157.5	10.2
1981	83.0	651.2	734.2	11.3	146.8	1 151.8	1 298.6	11.3
1982	73.8	502.5	576.3	12.8	120.5	820.5	941.0	12.8
1983	71.2	400.6	471.8	15.1	110.2	619.9	730.0	15.1
1984	146.9	470.4	617.3	23.8	220.2	705.3	925.5	23.8
1985	181.1	424.7	605.8	29.9	263.0	616.7	879.7	29.9
1986	348.6	374.7	723.3	48.2	491.5	528.2	1 019.7	48.2
1987	668.2	631.8	1 300.0	51.4	901.4	852.3	1 753.7	51.4
1988	668.3	681.8	1 350.1	49.5	862.1	879.6	1 741.7	49.5
1989	272.6	555.3	827.9	32.9	336.6	685.6	1 022.1	32.9
1990	241.0	533.7	774.7	31.1	288.2	638.2	926.3	31.1
1991	116.1	415.6	531.8	21.8	134.9	482.9	617.8	21.8
1992	79.9	305.4	385.3	20.7	91.6	350.2	441.8	20.7
1993	142.7	334.5	477.3	29.9	161.4	378.3	539.7	29.9
1994	195.8	432.3	628.1	31.2	218.9	483.2	702.1	31.2
1995	213.4	504.2	717.6	29.7	233.4	551.4	784.8	29.7
1996	313.9	580.9	894.8	35.1	337.7	625.0	962.7	35.1
1997	266.7	553.4	820.2	32.5	283.5	588.3	871.8	32.5
1998	155.9	420.0	575.9	27.1	166.4	448.3	614.6	27.1
1999	123.3	314.8	437.9	28.1	129.1	330.3	459.5	28.1
2000	142.3	315.8	458.1	31.1	143.8	319.1	462.9	31.1
2001	167.7	302.4	470.1	35.7	167.7	302.4	470.1	35.7

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

(1) Includes on-mine-site plus off-mine-site activities.

Note: Expenditures starting in 1997 include exploration plus deposit appraisal as per the new definitions; up to and including 1996, most of the expenditures now included in the deposit appraisal work phase were reported under exploration (broadly speaking).

TABLE 3b. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES, (1) BY JUNIOR AND SENIOR COMPANIES, 1997-2002

	Current Dollars				Constant 2001 Dollars			
	Share of Total			% of Total	Share of Total			% of Total
Year	Junior	Senior	Total	Junior	Junior	Senior	Total	Junior
	($ millions)				($ millions)			
1997	298.0	623.0	921.0	32.4	316.7	662.3	979.0	32.4
1998	170.5	485.4	655.9	26.0	182.0	518.0	700.1	26.0
1999	141.4	362.9	504.3	28.0	148.4	380.8	529.2	28.0
2000	156.0	340.7	496.7	31.4	157.6	344.3	501.8	31.4
2001	177.7	335.1	512.9	34.7	177.7	335.1	512.9	34.7
2002 (si)	209.3	291.8	501.1	41.8	208.9	291.2	500.2	41.8

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

(si) Company spending intentions, revised August 21, 2002.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

TABLE 3c. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] ON- AND OFF-MINE-SITE, BY JUNIOR AND SENIOR COMPANIES, 1997-2002

	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal		Exploration Plus Deposit Appraisal
	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On- and Off-Mine-Site
				($000)			
1997							
Junior	–	233 231	–	64 730	–	297 961	297 961
Senior	62 383	338 796	105 608	116 222	167 991	455 018	623 009
Total	62 383	572 027	105 608	180 951	167 991	752 979	920 970
1998							
Junior	–	144 970	–	25 573	–	170 544	170 544
Senior	67 875	249 959	61 535	106 018	129 411	355 977	485 387
Total	67 875	394 929	61 535	131 591	129 411	526 520	655 931
1999							
Junior	–	92 923	–	48 498	–	141 421	141 421
Senior	44 471	177 265	42 302	98 889	86 773	276 154	362 927
Total	44 471	270 188	42 302	147 386	86 773	417 575	504 348
2000							
Junior	–	127 853	–	28 109	–	155 962	155 962
Senior	30 743	183 929	42 273	83 744	73 016	267 672	340 689
Total	30 743	311 782	42 273	111 853	73 016	423 635	496 651
2001							
Junior	–	157 913	–	19 820	–	177 733	177 733
Senior	42 297	180 963	29 173	82 704	71 469	263 667	335 136
Total	42 297	338 876	29 173	102 524	71 469	441 400	512 869
2002 (si)							
Junior	–	167 863	–	41 461	–	209 324	209 324
Senior	53 330	138 884	49 838	49 718	103 168	188 602	291 769
Total	53 330	306 747	49 838	91 179	103 168	397 926	501 093

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil.

(si) Company spending intentions, revised August 21, 2002.

(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.

TABLE 4. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES, BY RANGE OF EXPENDITURES AND BY JUNIOR AND SENIOR COMPANIES, 1999 TO 2002

Range of Expenditures	Junior			Senior			Total		
	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures	Companies	Expenditures	Percentage of Total Expenditures
($)	(number)	($000)	(%)	(number)	($000)	(%)	(number)	($000)	(%)
1999									
>10 million	2	29 101	20.6	10	190 759	52.6	12		43.6
5 million-10 million	1	5 234	3.7	12	91 230	25.1	13	96 464	19.1
1 million-5 million	21	37 727	26.7	26	63 308	17.4	47	101 035	20.0
500 000-1 million	38	26 929	19.0	14	10 632	2.9	52	37 560	7.4
200 000-500 000	83	25 818	18.3	13	3 991	1.1	96	29 809	5.9
100 000-200 000	54	7 603	5.4	13	1 840	0.5	67	9 444	1.9
50 000-100 000	48	3 492	2.5	11	769	0.2	59	4 261	0.8
1-50 000	163	2 746	1.9	23	398	0.1	186	3 145	0.6
Subtotal	410	138 651	98.0	122	362 927	100.0	532	501 578	99.5
Prospectors (2)	25	2 770	2.0	–	–	–	25	2 770	0.5
Total 1999	435	141 421	100.0	122	362 927	100.0	557	504 348	100.0
2000									
>10 million	1	16 697	10.7	8	160 666	47.2	9	177 363	35.7
5 million-10 million	1	5 678	3.6	16	112 933	33.1	17	118 611	23.9
1 million-5 million	34	67 998	43.6	26	53 380	15.7	60	121 378	24.4
500 000-1 million	35	24 328	15.6	12	8 254	2.4	47	32 582	6.6
200 000-500 000	73	24 039	15.4	7	2 184	0.6	80	26 222	5.3
100 000-200 000	59	8 280	5.3	14	2 080	0.6	73	10 359	2.1
50 000-100 000	48	3 368	2.2	12	887	0.3	60	4 255	0.9
1-50 000	141	2 522	1.6	22	304	0.1	163	2 826	0.6
Subtotal	392	152 909	98.0	117	340 689	100.0	509	493 598	99.4
Prospectors (2)	32	3 053	2.0	–	–	–	32	3 053	0.6
Total 2000	424	155 962	100.0	117	340 689	100.0	541	496 651	100.0
2001									
>10 million	1	14 336	8.1	11	222 869	66.5	12	237 205	46.3
5 million-10 million	4	28 571	16.1	9	60 863	18.2	13	89 434	17.4
1 million-5 million	34	62 821	35.3	19	37 525	11.2	53	100 346	19.6
500 000-1 million	42	28 921	16.3	9	6 494	1.9	51	35 416	6.9
200 000-500 000	72	23 103	13.0	9	3 046	0.9	81	26 150	5.1
100 000-200 000	73	10 411	5.9	24	3 629	1.1	97	14 040	2.7
50 000-100 000	57	4 027	2.3	4	304	0.1	61	4 331	0.8
1-50 000	122	2 052	1.2	25	405	0.1	147	2 458	0.5
Subtotal	405	174 243	98.0	110	335 136	100.0	515	509 379	99.3
Prospectors (2)	38	3 490	2.0	–	–	–	38	3 490	0.7
Total 2001	443	177 733	100.0	110	335 136	100.0	553	512 869	100.0
2002 (si)									
>10 million	–	–	–	8	159 141	54.5	8	159 141	31.8
5 million-10 million	5	35 491	17.0	8	62 008	21.3	13	97 499	19.5
1 million-5 million	44	100 634	48.1	22	61 042	20.9	66	161 676	32.3
500 000-1 million	48	31 450	15.0	7	4 100	1.4	55	35 550	7.1
200 000-500 000	89	27 413	13.1	12	3 455	1.2	101	30 868	6.2
100 000-200 000	52	6 748	3.2	10	1 301	0.4	62	8 049	1.6
50 000-100 000	35	2 122	1.0	8	505	0.2	43	2 627	0.5
1-50 000	75	1 242	0.6	13	217	0.1	88	1 459	0.3
Subtotal	348	205 100	98.0	88	291 769	100.0	436	496 869	99.2
Prospectors (2)	36	4 224	2.0	–	–	–	36	4 224	0.8
Total 2002 (si)	384	209 324	100.0	88	291 769	100.0	472	501 093	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil; (si) Company spending intentions, revised August 21, 2002.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures. (2) Number of prospectors is under-estimated because it contains groups of prospectors.

Note: Numbers may not add to totals due to rounding.

TABLE 5. SUMMARY OF TOTAL DIAMOND EXPLORATION, DEPOSIT APPRAISAL AND MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] 1998-2001

Expenditure Category	1998	1999	2000	2001
		($ millions)		
Field work and overhead	148.9	83.9	95.0	240.2
Engineering, economic and pre- or production feasibility studies, environment and land access	36.7	25.0	55.2	27.5
Capital and repair (2)	161.4	76.0	281.8	619.8
Total	347.1	185.0	432.1	887.4

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes construction, and machinery and equipment expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 6a. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED IN CANADA, 1995-2001

Province/Territory	1995		1996		1997		1998		1999		2000		2001	
	(hectares)	(%) (3)	(hectares)	(%) (4)	(hectares)	(%) (5)	(hectares)	(%) (6)	(hectares)	(%) (7)	(hectares)	(%) (8)	(hectares)	(%) (9)
Newfoundland and Labrador	6 106 617	1 188.3	417 575	6.8	334 075	80.0	361 900	108.3	241 075	66.6	324 225	134.5	391 625	120.8
Nova Scotia	183 893	119.3	424 815	231.0	208 191	49.0	74 180	35.6	157 394	212.2	96 819	61.5	87 722	90.6
New Brunswick	60 464	94.9	93 760	155.1	53 760	57.3	40 000	74.4	28 336	70.8	49 344	174.1	35 712	72.4
Quebec	1 474 196	175.3	954 967	64.8	1 050 629	110.0	728 142	69.3	754 102	103.6	2 187 551	290.1	2 115 424	96.7
Ontario	668 832	91.1	903 488	135.1	855 584	94.7	577 632	67.5	604 096	104.6	874 896	144.8	981 904	112.2
Manitoba	670 316	48.2	325 452	48.6	386 243	118.7	475 634	123.1	(r) 801 550	168.5	(r) 1 759 381	219.5	1 054 106	59.9
Saskatchewan	340 881	18.8	469 040	137.6	950 253	202.6	680 048	71.6	(c) 161 083	23.7	523 440	325.0	558 131	106.6
Alberta	1 665 000	24.7	5 328 000	320.0	37 200 000	698.2	3 490 000	9.4	(b)1 026 000	29.4	2 349 600	229.0	4 192 055	178.4
British Columbia	845 550	109.2	997 740	118.0	765 257	76.7	474 296	62.0	478 740	100.9	699 050	146.0	636 800	91.1
Yukon	376 844	134.5	514 483	136.5	459 507	89.3	131 221	28.6	152 731	116.4	52 675	34.5	38 713	73.5
Northwest Territories	3 839 299	131.1	2 956 017	77.0	1 953 191	66.1	827 615	42.4	563 378	(c) 68.1	891 419	158.2	626 177	70.2
Nunavut	. .	. .	. .	. .	. .	. .	. .	. .	710 092	. .	498 230	70.2	441 270	88.6
Total	16 231 892	99.9	13 385 337	82.5	44 216 690	330.3	7 860 668	17.8	5 678 577	72.2	10 306 630	181.5	11 159 639	108.3

Source: Provincial and territorial mining recorders.
. . Not available; (r) Revised.
(a) Not strictly comparable to 1990 and earlier years because the total is the area of claims recorded and not the area of claims staked. (b) Prior to 1999, Saskatchewan data do not include exploration permits. (c) Percentage based on new claims staked in 1999 in the Northwest Territories and Nunavut combined.
(1) Excludes coal. (2) Percentage of 1994 over 1993. (3) Percentage of 1995 over 1994. (4) Percentage of 1996 over 1995. (5) Percentage of 1997 over 1996. (6) Percentage of 1998 over 1997. (7) Percentage of 1999 over 1998. (8) Percentage of 2000 over 1999. (9) Percentage of 2001 over 2000.
Note: Numbers may not add to totals due to rounding.

TABLE 6b. AREA[1] OF NEW MINERAL CLAIMS STAKED OR RECORDED IN CANADA, 1999-2001

Province/Territory	1999		2000		2001	
	(hectares)	(%)	(hectares)	(%)	(hectares)	(%)
Newfoundland and Labrador	241 075	4.2	324 225	3.1	391 625	3.5
Nova Scotia	157 304	2.8	96 619	0.9	87 722	0.8
New Brunswick	28 336	0.5	49 344	0.5	35 712	0.3
Quebec	754 102	13.3	2 187 551	21.2	2 115 424	19.0
Ontario	604 096	10.6	874 896	8.5	981 904	8.8
Manitoba	(r) 801 550	14.1	(r) 1 759 381	17.1	1 054 106	9.4
Saskatchewan	161 083	2.8	523 440	5.1	558 131	5.0
Alberta	1 026 000	18.1	2 349 800	22.8	4 192 055	37.6
British Columbia	478 740	8.4	699 050	6.8	636 800	5.7
Yukon	152 731	2.7	52 675	0.5	38 713	0.3
Northwest Territories	563 378	9.9	891 419	8.6	626 177	5.6
Nunavut	710 082	12.5	498 230	4.8	441 270	4.0
Total	5 678 577	100.0	10 306 630	100.0	11 159 639	100.0

Source: Provincial and territorial mining recorders.
(r) Revised.
(1) Excludes coal.
Note: Numbers may not add to totals due to rounding.

TABLE 7a. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES,[1] BY PROVINCE AND TERRITORY, 2000

Province/Territory	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
				($000)		
Newfoundland and Labrador	16 181	1 014	10 014	108	26 195	1 122
Nova Scotia	3 003	–	582	–	3 585	–
New Brunswick	9 687	510	28	1 900	9 715	2 410
Quebec	66 753	4 968	3 432	18 963	70 185	23 931
Ontario	58 672	19 060	25 999	14 209	84 671	33 268
Manitoba	21 808	3 073	1 465	1 774	23 273	4 847
Saskatchewan	25 357	426	18 054	1 753	43 411	2 179
Alberta	6 494	–	734	10	7 227	10
British Columbia	26 715	992	5 538	2 678	32 254	3 670
Yukon	9 014	–	2 143	76	11 157	76
Northwest Territories	30 379	–	20 683	307	51 062	307
Nunavut	37 719	700	23 180	496	60 899	1 196
Total	311 782	30 743	111 853	42 273	423 635	73 016
Total (on- plus off-mine-site)	342 525		154 126		496 651	

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 7b. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES, BY PROVINCE AND TERRITORY, 2001

Province/Territory	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
				($000)		
Newfoundland and Labrador	17 996	34	10 179	233	28 175	267
Nova Scotia	1 101	135	1 583	–	2 684	135
New Brunswick	7 259	–	–	2 200	7 259	2 200
Quebec	59 082	19 253	15 255	9 357	74 337	28 610
Ontario	81 325	15 545	5 115	11 655	86 440	27 200
Manitoba	23 452	2 447	654	2 114	24 106	4 561
Saskatchewan	23 967	1 646	11 923	–	35 889	1 646
Alberta	3 861	592	–	–	3 861	592
British Columbia	23 459	1 939	2 586	1 153	26 045	3 092
Yukon	7 401	–	406	–	7 807	–
Northwest Territories	37 627	–	46 557	2 461	84 184	2 461
Nunavut	52 347	706	8 266	–	60 612	706
Total	338 876	42 297	102 524	29 173	441 400	71 469
Total (on- plus off-mine-site)	381 173		131 697		512 869	

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 7c. EXPLORATION AND DEPOSIT APPRAISAL, OFF-MINE-SITE AND ON-MINE-SITE EXPENDITURES, [1] BY PROVINCE AND TERRITORY, 2002

Province/Territory	Exploration		Deposit Appraisal		Exploration Plus Deposit Appraisal	
	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site	Off-Mine-Site	On-Mine-Site
			($000)			
Newfoundland and Labrador	14 040	2 150	1 390	210	15 430	2 360
Nova Scotia	2 204	–	3 689	–	5 893	–
New Brunswick	2 500	–	34	1 100	2 534	1 100
Quebec	60 662	17 225	3 241	27 912	63 903	45 137
Ontario	57 856	25 282	27 141	16 398	84 997	41 680
Manitoba	22 235	4 259	129	3 578	22 364	7 837
Saskatchewan	27 108	240	13 574	500	40 683	740
Alberta	8 193	600	–	–	8 193	660
British Columbia	30 276	1 924	12 663	40	42 939	1 964
Yukon	7 230	–	24	–	7 254	–
Northwest Territories	21 289	–	16 280	100	37 569	100
Nunavut	53 153	1 590	13 014	–	66 167	1 590
Total	306 747	53 330	91 179	49 838	397 926	103 168
Total (on- plus off-mine-site)	360 076		141 017		501 093	

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Notes: Data for 2002 are company spending intentions, revised August 21, 2002. Numbers may not add to totals due to rounding.

TABLE 8. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES, [1] BY PROVINCE AND TERRITORY, 1999-2002

Province / Territory	1999		2000			2001			2002 (si)		
					2000 as a % of 1999 Expenditures			2001 as a % of 2000 Expenditures			2002 as a % of 2001 Expenditures
	($ millions)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)	($ millions)	(%)	(%)
Newfoundland and Labrador	31.3	6.2	27.3	5.5	87.3	28.4	5.5	104.1	17.8	3.6	62.5
Nova Scotia	5.3	1.0	3.6	0.7	68.2	2.8	0.5	78.6	5.9	1.2	209.0
New Brunswick	10.1	2.0	12.1	2.4	119.9	9.5	1.8	78.0	3.6	0.7	38.4
Quebec	113.5	22.5	94.1	19.0	82.9	102.9	20.1	109.4	109.0	21.8	105.9
Ontario	87.4	17.3	117.0	23.7	135.0	113.6	22.2	96.4	126.7	25.3	111.5
Manitoba	22.8	4.5	28.1	5.7	123.1	28.7	5.6	101.9	30.2	6.0	105.4
Saskatchewan	43.6	8.6	45.6	9.2	104.6	37.5	7.3	82.3	41.4	8.3	110.4
Alberta	14.7	2.9	7.2	1.5	49.1	4.5	0.9	61.5	8.9	1.8	198.8
British Columbia	41.3	8.2	35.9	7.2	87.0	29.1	5.7	81.1	44.9	9.0	154.1
Yukon Territory	12.7	2.5	11.2	2.3	88.1	7.8	1.5	69.5	7.3	1.4	92.9
Northwest Territories	84.1	16.7	51.4	10.3	61.1	86.6	16.9	168.7	37.7	7.5	43.5
Nunavut	37.4	7.4	62.1	12.5	166.0	61.3	12.0	98.7	67.8	13.5	110.5
Total	504.3	100.0	496.7	100.0	98.5	512.9	100.0	103.3	501.1	100.0	97.7
Exploration	314.7	62.4	342.5	69.0	108.9	381.2	74.3	111.3	360.1	71.9	94.5
Deposit appraisal	189.7	37.6	154.1	31.0	81.3	131.7	25.7	85.4	141.0	28.1	107.1

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
(si) Company spending intentions, revised August 21, 2002.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environment and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 9a. EXPLORATION ACTIVITY,[1] BY PROVINCE AND TERRITORY, 2000

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre-Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	60	8 002	–	–	497	2 579	2 082	889	560	901	96	–	16	1 527	46	19	17 195
Nova Scotia	8	557	–	–	161	717	97	522	277	51	12	10	151	373	30	46	3 003
New Brunswick	66	4 633	–	–	370	866	2 648	295	186	153	–	–	–	947	23	75	10 197
Quebec	381	31 484	5	515	2 442	15 569	4 565	2 859	3 957	1 853	643	197	671	6 777	117	101	71 721
Ontario	498	34 608	. . .	17	2 796	11 229	5 414	2 226	3 943	8 074	25	105	1 894	6 329	148	923	77 732
Manitoba	116	12 176	–	–	1 864	1 615	3 321	1 023	974	963	1	9	–	2 832	6	97	24 881
Saskatchewan	108	13 295	1	1 275	845	1 597	2 615	1 108	151	1 011	445	–	–	3 400	41	2	25 784
Alberta	4	893	12	1 330	189	935	594	300	5	563	396	–	–	1 159	77	52	6 494
British Columbia	157	9 351	2	145	1 875	5 812	1 345	352	949	1 091	1 552	77	82	3 430	1 270	376	27 707
Yukon	11	3 069	–	–	1 504	1 712	209	763	670	432	7	–	–	595	13	40	9 014
Northwest Territories	37	11 096	2	325	4 280	2 762	2 574	4 763	–	1 446	129	–	–	2 633	115	256	30 379
Nunavut	65	16 584	1	100	5 266	5 667	2 973	2 109	416	1 065	17	–	–	3 302	269	641	38 419
Total	1 490	145 728	22	3 706	22 089	51 060	28 438	17 191	12 088	17 601	3 323	398	2 813	33 306	2 156	2 627	342 525
Percentage of grand total	n.a.	42.5	n.a.	1.1	6.4	14.9	8.3	5.0	3.5	5.1	1.0	0.1	0.8	9.7	0.6	0.8	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9b. DEPOSIT APPRAISAL ACTIVITY,[1] BY PROVINCE AND TERRITORY, 2000

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)	($000)												
Newfoundland and Labrador	13	2 987	–	–	60	214	208	–	2 060	28	2 416	4	585	494	586	491	10 122
Nova Scotia	–	–	. . .	50	–	–	30	–	–	10	60	15	261	119	37	–	582
New Brunswick	30	1 900	. . .	. . .	–	21	–	–	5	–	–	–	–	2	–	–	1 928
Quebec	124	4 985	. . .	. . .	33	621	36	–	12 643	484	1 081	41	812	1 096	570	14	22 395
Ontario	236	17 421	5	5 023	50	4 245	197	–	9 650	38	289	5	406	2 480	223	175	40 208
Manitoba	27	1 463	–	–	69	–	–	–	666	505	104	28	–	253	102	–	3 239
Saskatchewan	28	1 517	. . .	1 060	–	147	209	–	6 951	2 021	2 104	–	1 372	2 817	1 383	235	19 806
Alberta	–	–	–	–	–	–	–	–	–	–	13	51	–	148	546	–	744
British Columbia	24	2 206	–	–	19	1 521	50	15	136	150	1 258	91	292	1 495	371	601	8 217
Yukon	2	370	–	–	5	232	–	–	16	223	499	80	390	150	374	40	2 219
Northwest Territories	20	2 797	2	2 237	165	524	35	100	8 313	445	664	20	3 900	828	1 820	2	20 990
Nunavut	57	14 788	–	–	–	794	25	–	650	990	1 492	10	620	2 616	1 580	108	23 677
Total	550	50 414	9	8 370	399	8 310	781	115	41 111	4 874	9 980	342	7 683	12 498	7 567	1 665	154 126
Percentage of grand total	n.a.	32.7	n.a.	5.4	0.3	5.4	0.5	0.1	26.7	3.2	6.5	0.2	5.0	8.1	4.9	1.1	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9c. EXPLORATION PLUS DEPOSIT APPRAISAL ACTIVITIES, (1) BY PROVINCE AND TERRITORY, 2000

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)	($000)												
Newfoundland and Labrador	73	10 969	–	–	567	2 792	2 290	869	2 651	928	2 511	4	601	2 021	612	510	27 317
Nova Scotia	8	557	. . .	50	161	717	127	522	277	61	72	25	411	492	67	46	3 585
New Brunswick	96	6 533	. . .	. . .	370	887	2 648	295	191	153	–	–	–	949	23	75	12 125
Quebec	484	36 439	5	515	2 474	16 191	4 602	2 850	16 601	2 317	1 723	239	1 483	7 873	688	115	94 116
Ontario	733	52 029	6	5 040	2 846	15 474	5 610	2 220	13 593	8 113	314	108	2 300	8 819	371	1 098	117 939
Manitoba	142	13 640	–	–	1 932	1 615	3 321	1 023	1 630	1 468	165	37	–	3 085	108	97	28 121
Saskatchewan	134	14 812	2	2 335	845	1 743	2 816	1 109	7 101	3 032	2 549	–	1 372	6 216	1 425	237	45 590
Alberta	4	893	12	1 330	189	935	594	300	5	563	409	51	–	1 299	618	52	7 237
British Columbia	182	11 557	2	145	1 894	7 333	1 395	388	1 084	1 241	2 821	168	374	4 926	1 642	977	35 924
Yukon	13	3 439	–	–	1 500	1 944	209	763	686	655	506	80	330	745	287	80	11 233
Northwest Territories	57	13 893	4	2 562	4 445	3 286	2 609	4 863	8 313	1 891	734	20	3 000	3 461	2 035	258	51 369
Nunavut	123	31 381	1	100	5 266	6 461	2 997	2 109	1 066	2 055	1 508	10	626	5 918	1 849	749	62 096
Total	2 049	196 142	31	12 076	22 489	59 378	29 219	17 306	53 199	22 476	13 312	740	10 497	45 804	9 723	4 292	496 651
Percentage of grand total	n.a.	39.5	n.a.	2.4	4.5	12.0	5.9	3.5	10.7	4.5	2.7	0.1	2.1	9.2	2.0	0.9	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 9d. MINE COMPLEX DEVELOPMENT ACTIVITY, (1) BY PROVINCE AND TERRITORY, 2000

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)	($000)												
Newfoundland and Labrador	2	143	147	2 249	33	60	–	–	8 624	1	20	–	–	110	114	8	11 361
Nova Scotia	7	380	108	343	–	133	19	–	2 768	97	98	15	–	511	320	37	4 720
New Brunswick	25	5 434	22	8 800	32	62	–	–	26 303	–	–	–	–	88	2 327	–	43 045
Quebec	197	16 637	49	2 935	478	1 878	50	–	201 838	30 442	15 617	–	–	23 180	7 676	622	301 354
Ontario	506	24 742	175	4 380	40	5 774	91	–	191 337	541	2 298	–	–	2 578	4 954	15	236 750
Manitoba	151	7 101	–	–	372	529	47	–	48 984	109	510	–	–	1 032	114	–	58 798
Saskatchewan	52	9 131	14	256	–	723	892	–	12 637	1 752	80	–	56	9 534	6 966	–	42 027
Alberta	4	458	13	490	–	80	–	–	22 760	148	798	55	110	4 884	634	43	30 460
British Columbia	88	4 036	436	3 604	612	1 881	9	–	9 701	–	2 308	–	–	5 691	6 966	357	35 165
Yukon	–	–		–	–	–	–	–	–	–	31	–	–	–	–	–	31
Northwest Territories	2	250	. . .	258	–	474	–	–	4 481	249	28 694	7 000	–	13 279	2 338	9 007	66 030
Nunavut	–	–	–	–	–	22	–	–	412	–	–	–	–	338	478	–	1 250
Total	1 031	68 312	965	23 315	1 566	11 616	1 108	–	529 845	33 338	50 455	7 070	165	61 226	32 885	10 089	830 991
Percentage of grand total	n.a.	8.2	n.a.	2.8	0.2	1.4	0.1	–	63.8	4.0	6.1	0.9	. . .	7.4	4.0	1.2	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed; n.a. Not applicable.
(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.
Note: Numbers may not add to totals due to rounding.

TABLE 10a. SUMMARY OF DRILLING ACTIVITY IN CANADA, 2000

Drilling Activity	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal
	Off-Mine-Site		On-Mine-Site		Off-Mine-Site		On-Mine-Site		On- Plus Off-Mine-Site
	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)
Diamond drilling									
Surface	1 161 783	96.2	66 423	23.6	109 860	55.7	15 442	4.3	1 353 508
Underground	45 840	3.8	215 580	76.4	87 484	44.3	346 504	95.7	695 408
Subtotal	1 207 623	100.0	282 003	100.0	197 344	100.0	361 946	100.0	2 048 916
Percentage of off- plus on-mine-site diamond drilling	81.1		18.9		35.3		64.7		
Other drilling									
Surface	17 332	100.0	4 776	100.0	8 133	95.2	–	–	30 241
Underground	–	–	–	–	407	4.8	2	100.0	409
Subtotal	17 332	100.0	4 776	100.0	8 540	100.0	2	100.0	30 650
Percentage of off- plus on-mine-site other drilling	78.4		21.6		100.0		. . .		
Total surface drilling	1 179 115		71 199		117 993		15 442		1 383 749
Total underground drilling	45 840		215 580		87 891		346 506		695 817
Grand total	1 224 955		286 779		205 884		361 948		2 079 566

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
Note: Numbers may not add to totals due to rounding.

TABLE 10b. SUMMARY OF DRILLING ACTIVITY IN CANADA, 2001

Drilling Activity	Exploration				Deposit Appraisal				Exploration Plus Deposit Appraisal
	Off-Mine-Site		On-Mine-Site		Off-Mine-Site		On-Mine-Site		On- Plus Off-Mine-Site
	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)	(% of subtotal)	(metres)
Diamond drilling									
Surface	1 036 264	98.7	163 666	53.0	102 449	87.6	24 044	11.8	1 326 423
Underground	13 496	1.3	145 218	47.0	14 476	12.4	179 674	88.2	352 864
Subtotal	1 049 760	100.0	308 884	100.0	116 925	100.0	203 718	100.0	1 679 287
Percentage of off- plus on-mine-site diamond drilling	77.3		22.7		36.5		63.5		
Other drilling									
Surface	63 032	100.0	–	–	4 319	100.0	–	–	67 351
Underground	–	–	19 561	100.0	–	–	–	–	19 561
Subtotal	63 032	100.0	19 561	100.0	4 319	100.0	–	–	86 912
Percentage of off- plus on-mine-site other drilling	76.3		23.7		100.0		–		
Total surface drilling	1 099 296		163 666		106 768		24 044		1 393 774
Total underground drilling	13 496		164 779		14 476		179 674		372 425
Grand total	1 112 792		328 445		121 244		203 718		1 766 199

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 11a. EXPLORATION PLUS DEPOSIT APPRAISAL (SURFACE DRILLING), (1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2000

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					(000 metres)				
Newfoundland and Labrador	45	13	–	–	11	2	–	–	71
Nova Scotia	1	4	. . .	–	1	2	–	–	9
New Brunswick	39	15	–	–	2	. . .	–	–	56
Quebec	159	169	–	–	18	3	. . .	–	349
Ontario	133	183	–	–	7	4	11	–	337
Manitoba	87	11	–	–	1	–	–	–	98
Saskatchewan	18	8	. . .	76	. . .	–	7	–	110
Alberta	–	1	–	–	–	–	5	9	16
British Columbia	57	97	. . .	–	–	8	. . .	. . .	168
Yukon	5	8	–	–	–	–	–	–	13
Northwest Territories	7	7	–	–	4	–	41	–	60
Nunavut	15	70	–	. . . –	3	–	9	–	97
Total	565	587	. . .	76	53	19	73	9	1 384

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil, . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.
Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 11b. EXPLORATION PLUS DEPOSIT APPRAISAL (UNDERGROUND DRILLING), (1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2000

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					(000 metres)				
Newfoundland and Labrador	–	2	–	–	–	–	–	–	2
Nova Scotia	–	–	–	–	–	–	–	–	–
New Brunswick	24	16	–	–	–	. . .	–	–	40
Quebec	36	104	–	–	–	–	–	–	140
Ontario	118	276	–	–	7	–	–	–	401
Manitoba	29	15	–	–	–	–	–	–	44
Saskatchewan	3	22	–	1	–	–	–	–	26
Alberta	–	–	–	–	–	–	–	–	–
British Columbia	8	8	–	–	–	–	–	–	15
Yukon	–	–	–	–	–	–	–	–	–
Northwest Territories	–	–	–	–	–	–	1	–	1
Nunavut	7	19	–	–	–	–	–	–	26
Total	224	462	–	1	7	. . .	1	–	696

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.
(1) Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.
Note: Numbers may not add to totals due to rounding.

TABLE 12a. COMPARISON OF 1999 AND 2000 EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES, (1) BY MINERAL COMMODITY SOUGHT

Mineral Commodity	1999 Expenditures	2000 as % of 1999 Expenditures	2000 Total Expenditures			Percentage of Canadian Total
			On-Mine-Site	Off-Mine-Site	On-Mine-Site Plus Off-Mine-Site	
	($ millions)	(%)		($ millions)		(%)
Base metals (2)	139.3	106.2	20.9	127.2	148.0	29.8
Precious metals (3)	181.0	107.0	49.1	144.5	193.6	39.0
Iron ore	4.4	18.8	–	0.8	0.8	0.2
Uranium	35.2	96.4	–	33.9	33.9	6.8
Other metals	15.5	112.0	1.3	16.1	17.4	3.5
Nonmetals	12.0	65.9	1.5	6.4	7.9	1.6
Diamonds	108.7	84.6	0.3	91.6	91.9	18.5
Coal	8.2	36.5	–	3.0	3.0	0.6
Total	504.3	98.5	73.0	423.6	496.7	100.0

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.
– Nil
(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.
(2) Includes copper, nickel, lead and zinc. (3) Includes silver, gold, and platinum group metals.
Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 12b. COMPARISON OF 2000 AND 2001 EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) BY MINERAL COMMODITY SOUGHT

Mineral Commodity	2000 Expenditures	2001 as % of 2000 Expenditures	2001 Total Expenditures			Percentage of Canadian Total
			On-Mine-Site	Off-Mine-Site	On-Mine-Site Plus Off-Mine-Site	
	($ millions)	(%)		($ millions)		(%)
Base metals (2)	148.0	94.2	19.8	119.6	139.4	27.2
Precious metals (3)	193.6	86.2	42.9	124.0	166.9	32.5
Iron Ore	0.8	267.2	0.3	2.0	2.2	0.4
Uranium	33.9	79.8	1.5	25.6	27.1	5.3
Other Metals	17.4	106.2	0.8	17.6	18.5	3.6
Nonmetals	7.9	108.3	1.8	6.8	8.6	1.7
Diamonds	91.9	157.4	2.5	142.2	144.7	28.2
Coal	3.0	183.1	1.9	3.5	5.5	1.1
Total	496.7	103.3	71.5	441.4	512.9	100.0

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

(2) Includes copper, nickel, lead and zinc. (3) Includes silver, gold, and platinum group metals.

Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 13a. EXPLORATION EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland and Labrador	10 761	3 211	511	–	2 566	138	–	8	17 195
Nova Scotia	338	964	68	–	170	1 459	–	4	3 003
New Brunswick	6 642	3 222	–	–	280	52	–	–	10 197
Quebec	30 360	28 408	–	22	4 600	1 269	7 062	–	71 721
Ontario	26 786	41 968	–	22	2 211	550	6 194	–	77 732
Manitoba	18 443	3 922	–	–	242	1	2 274	–	24 881
Saskatchewan	3 268	1 863	65	16 536	170	–	3 729	152	25 784
Alberta	25	1 262	–	101	129	–	4 187	789	6 494
British Columbia	8 680	15 124	16	–	1 340	1 929	27	591	27 707
Yukon	2 592	6 343	–	–	79	–	–	–	9 014
Northwest Territories	3 523	3 221	67	–	946	–	22 622	–	30 379
Nunavut	10 050	15 440	102	221	789	–	11 818	–	38 419
Total	121 469	124 948	829	16 902	13 523	5 398	57 914	1 543	342 525

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre-feasibility studies,

Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 13b. DEPOSIT APPRAISAL EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2000

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					($000)				
Newfoundland and Labrador	3 135	5 089	–	–	1 370	514	13	–	10 122
Nova Scotia	174	41	–	–	367	–	–	–	582
New Brunswick	1 140	760	–	–	–	28	–	–	1 928
Quebec	6 530	15 173	–	–	490	202	–	–	22 395
Ontario	6 792	19 308	–	–	810	181	13 118	–	40 208
Manitoba	3 034	72	–	–	33	100	–	–	3 239
Saskatchewan	1 028	1 553	–	17 026	–	200	–	–	19 806
Alberta	–	–	–	–	–	10	–	734	744
British Columbia	2 227	3 888	–	–	113	1 270	–	719	8 217
Yukon	1 290	929	–	–	–	–	–	–	2 219
Northwest Territories	775	467	–	–	688	–	19 060	–	20 990
Nunavut	441	21 392	–	–	–	–	1 844	–	23 677
Total	26 566	68 670	–	17 026	3 871	2 506	34 035	1 453	154 126

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 13c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2000

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	13 897	8 300	511	–	3 936	652	13	8	27 317
Nova Scotia	512	1 005	68	–	537	1 459	–	4	3 585
New Brunswick	7 782	3 982	–	–	280	80	–	–	12 125
Quebec	36 890	43 580	–	22	5 090	1 472	7 062	–	94 116
Ontario	33 578	61 276	–	22	3 021	731	19 312	–	117 939
Manitoba	21 477	3 994	–	–	275	101	2 274	–	28 121
Saskatchewan	4 296	3 416	65	33 562	170	200	3 729	152	45 590
Alberta	25	1 262	–	101	129	10	4 187	1 522	7 237
British Columbia	10 907	19 012	16	–	1 453	3 199	27	1 310	35 924
Yukon	3 882	7 272	–	–	79	–	–	–	11 233
Northwest Territories	4 298	3 687	67	–	1 635	–	41 682	–	51 369
Nunavut	10 491	36 831	102	221	789	–	13 662	–	62 096
Total	148 035	193 618	829	33 928	17 393	7 904	91 949	2 996	496 651

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.
Note: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 13d. MINE COMPLEX DEVELOPMENT EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2000

	Metals								
Province/Territory	Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	–	–	10 738	–	–	623	–	–	11 361
Nova Scotia	–	8	–	–	–	3 111	–	1 602	4 720
New Brunswick	24 326	16 214	–	–	–	2 505	–	–	43 045
Quebec	54 345	84 418	85 801	–	34 863	41 926	–	–	301 354
Ontario	72 027	161 279	–	–	1 096	2 347	–	–	236 750
Manitoba	49 499	9 093	–	–	103	103	–	–	58 798
Saskatchewan	4 835	730	–	22 585	–	11 477	–	2 400	42 027
Alberta	–	–	–	–	–	55	–	30 405	30 460
British Columbia	5 022	3 008	–	–	2 998	831	–	23 307	35 165
Yukon	10	21	–	–	–	–	–	–	31
Northwest Territories	–	7 720	–	–	–	–	58 310	–	66 030
Nunavut	1 081	169	–	–	–	–	–	–	1 250
Total	211 144	282 660	96 539	22 585	39 060	62 979	58 310	57 713	830 991

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.
– Nil.
(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.
Note: Numbers may not add to totals due to rounding.

TABLE 14a. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY JUNIOR AND SENIOR COMPANIES AND MINERAL COMMODITY SOUGHT, 2000

Work Phase/ Type of Company	Base Metals	Precious Metals	Uranium	Diamonds	Others	Total
			($000)			
Exploration, off-mine-site						
Junior companies and prospectors	38 698	54 143	3 714	20 756	10 543	127 853
Senior companies	74 958	48 452	13 188	37 155	10 176	183 929
Total	113 656	102 595	16 902	57 911	20 718	311 782
Exploration, on-mine-site						
Junior companies and prospectors	–	–	–	–	–	–
Senior companies	7 733	22 264	–	–	747	30 743
Total	7 733	22 264	–	–	747	30 743
Exploration, off- plus on-mine-site						
Junior companies and prospectors	38 698	54 143	3 714	20 756	10 543	127 853
Senior companies	82 691	70 715	13 188	37 155	10 923	214 672
Total	121 389	124 858	16 902	57 911	21 465	342 525
Deposit appraisal, off-mine-site						
Junior companies and prospectors	5 449	18 070	–	1 857	2 734	28 109
Senior companies	7 993	23 791	17 026	31 871	3 063	83 744
Total	13 442	41 861	17 026	33 728	5 796	111 853
Deposit appraisal, on-mine-site						
Junior companies and prospectors	–	–	–	–	–	–
Senior companies	13 124	26 810	–	307	2 033	42 273
Total	13 124	26 810	–	307	2 033	42 273
Deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	5 449	18 070	–	1 857	2 734	28 109
Senior companies	21 117	50 600	17 026	32 178	5 096	126 017
Total	26 566	68 670	17 026	34 035	7 829	154 126
Exploration plus deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	44 146	72 213	3 714	22 613	13 276	155 962
Senior companies	103 809	121 316	30 214	69 333	16 018	340 689
Total	147 955	193 529	33 928	91 946	29 294	496 651

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 14b. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES, (1) BY JUNIOR AND SENIOR COMPANIES AND MINERAL COMMODITY SOUGHT, 2001

Work Phase/ Type of Company	Base Metals	Precious Metals	Uranium	Diamonds	Others	Total
			($000)			
Exploration, off-mine-site						
Junior companies and prospectors	40 026	65 143	1 973	38 039	12 732	157 913
Senior companies	59 998	43 841	11 690	57 477	7 956	180 963
Total	100 024	108 984	13 664	95 516	20 687	338 876
Exploration, on-mine-site						
Junior companies and prospectors	–	–	–	–	–	–
Senior companies	14 095	24 147	1 503	–	2 552	42 297
Total	14 095	24 147	1 503	–	2 552	42 297
Exploration, off- plus on-mine-site						
Junior companies and prospectors	40 026	65 143	1 973	38 039	12 732	157 913
Senior companies	74 093	67 988	13 193	57 477	10 508	223 260
Total	114 119	133 131	15 166	95 516	23 240	381 173
Deposit appraisal, off-mine-site						
Junior companies and prospectors	4 267	11 297	–	1 102	3 154	19 820
Senior companies	15 350	3 721	11 923	45 617	6 093	82 704
Total	19 618	15 018	11 923	46 719	9 247	102 524
Deposit appraisal, on-mine-site						
Junior companies and prospectors	–	–	–	–	–	–
Senior companies	5 706	18 773	–	2 461	2 232	29 173
Total	5 706	18 773	–	2 461	2 232	29 173
Deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	4 267	11 297	–	1 102	3 154	19 820
Senior companies	21 057	22 494	–	48 078	8 325	111 877
Total	25 324	33 791	11 923	49 180	11 479	131 697
Exploration plus deposit appraisal, off- plus on-mine-site						
Junior companies and prospectors	44 293	76 440	1 973	39 141	15 885	177 733
Senior companies	95 150	90 482	25 116	105 555	18 833	335 136
Total	139 443	166 922	27 089	144 697	34 719	512 869

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 15a. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY JUNIOR AND SENIOR COMPANIES, 2000

	Exploration			Deposit Appraisal			Exploration Plus Deposit Appraisal		
Province/Territory	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total
					($000)				
Newfoundland and Labrador	7 343	9 851	17 195	1 247	8 875	10 122	8 591	18 726	27 317
Nova Scotia	2 950	53	3 003	582	–	582	3 532	53	3 585
New Brunswick	1 858	8 339	10 197	–	1 928	1 928	1 858	10 267	12 125
Quebec	23 898	47 823	71 721	822	21 573	22 395	24 720	69 396	94 116
Ontario	26 184	51 548	77 732	880	39 327	40 208	27 064	90 875	117 939
Manitoba	4 296	20 585	24 881	1 465	1 774	3 239	5 761	22 359	28 121
Saskatchewan	7 926	17 858	25 784	1 028	18 779	19 806	8 953	36 637	45 590
Alberta	2 847	3 647	6 494	–	744	744	2 847	4 390	7 237
British Columbia	16 924	10 783	27 707	1 660	6 557	8 217	18 584	17 340	35 924
Yukon	6 181	2 833	9 014	2 040	179	2 219	8 221	3 012	11 233
Northwest Territories	11 375	19 004	30 379	1 805	19 186	20 990	13 179	38 190	51 369
Nunavut	16 072	22 347	38 419	16 580	7 096	23 677	32 653	29 443	62 096
Total	127 853	214 672	342 525	28 109	126 017	154 126	155 962	340 689	496 651

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 15b. EXPLORATION AND DEPOSIT APPRAISAL EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY JUNIOR AND SENIOR COMPANIES, 2001

	Exploration			Deposit Appraisal			Exploration Plus Deposit Appraisal		
Province/Territory	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total	Junior Companies and Prospectors	Senior Companies	Total
					($000)				
Newfoundland and Labrador	5 824	12 206	18 030	1 333	9 079	10 412	7 157	21 285	28 442
Nova Scotia	1 035	201	1 236	1 571	12	1 583	2 606	213	2 819
New Brunswick	3 263	3 996	7 259	–	2 200	2 200	3 263	6 196	9 459
Quebec	26 541	51 793	78 335	3 494	21 118	24 612	30 035	72 911	102 947
Ontario	37 997	58 873	96 870	1 728	15 042	16 769	39 725	73 915	113 640
Manitoba	6 515	19 383	25 898	654	2 114	2 768	7 169	21 497	28 667
Saskatchewan	7 222	18 390	25 613	–	11 923	11 923	7 222	30 313	37 535
Alberta	1 500	2 953	4 453	–	–	–	1 500	2 953	4 453
British Columbia	16 137	9 261	25 398	2 181	1 558	3 739	18 318	10 819	29 137
Yukon	5 092	2 309	7 401	406	–	406	5 499	2 309	7 807
Northwest Territories	14 169	23 458	37 627	940	48 078	49 018	15 109	71 537	86 645
Nunavut	32 617	20 436	53 053	7 513	753	8 266	40 130	21 189	61 318
Total	157 913	223 260	381 173	19 820	111 877	131 697	177 733	335 136	512 869

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLEAU 16a. ACTIVITÉS[1] D'EXPLORATION, PAR PROVINCE ET PAR TERRITOIRE, EN 2001

	Forage en surface et forage souterrain						Géophysique										
	Forage au diamant		Autres types de forage														
Province/territoire	Mètres	Coût	Mètres	Coût	Géochimie	Géologie	Au sol	Aéroportée	Travaux dans la roche (2)	Autres coûts sur le terrain	Ingénierie	Économique	Études de préfaisabilité du projet	Baux miniers et activités du siège social reliées au projet	Environnement	Accès au territoire	Total général
	(milliers)	(k$)	(milliers)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)	(k$)
Terre-Neuve-et-Labrador	41	5 178	1	16	839	4 114	1 482	473	1 470	2 293	19	3	1	2 074	34	33	18 030
Nouvelle-Écosse	3	196	1	67	92	280	160	–	52	25	22	–	35	218	48	41	1 236
Nouveau-Brunswick	41	2 783	12	588	342	1 382	437	139	124	111	14	–	–	1 305	35	1	7 259
Québec	346	27 115	. . .	20	2 058	14 539	8 264	5 742	7 074	3 844	169	7	46	8 749	517	190	78 335
Ontario	420	30 911	10	10 415	4 984	20 301	7 326	6 500	5 166	2 396	150	50	259	7 034	215	1 164	96 870
Manitoba	100	10 860	3	120	1 466	2 191	2 712	1 843	965	1 580	1	–	–	4 070	23	65	25 898
Saskatchewan	88	11 643	11	4 010	356	1 173	3 517	580	2	1 712	150	–	–	2 433	25	12	25 613
Alberta	7	1 317	31	718	139	201	271	127	–	162	157	–	–	1 329	15	16	4 453
Colombie-Britannique	182	10 946	–	–	1 623	4 090	853	153	1 058	871	157	72	10	2 922	1 653	390	25 398
Territoire du Yukon	12	2 791	–	–	667	2 379	282	122	561	121	–	–	–	326	145	27	7 401
Territoires du Nord-Ouest	27	10 587	6	5 409	4 144	3 796	2 937	5 468	15	760	92	32	103	3 855	34	398	37 627
Nunavut	91	23 569	7	3 192	3 440	9 180	1 930	2 375	2 823	484	25	–	–	5 370	389	274	53 053
Total	1 359	137 895	83	24 556	20 151	64 224	30 151	23 522	19 311	14 359	955	164	454	39 684	3 134	2 612	381 173
Pourcentage du total général	s.o.	36,2	s.o.	6,4	5,3	16,8	7,9	6,2	5,1	3,8	0,3	. . .	0,1	10,4	0,8	0,7	100,0

Source : Établi par Ressources naturelles Canada, à partir d'un relevé fédéral-provincial-territorial auprès des sociétés d'exploration et d'exploitation minières.

– : néant; . . . : quantité minime; k$: millier de dollars; s.o. : sans objet.

(1) Cette catégorie englobe les activités sur un site minier et hors d'un site minier. (2) Cette catégorie inclut également les coûts consacrées au décapage, au creusage des tranchées, au fonçage de puits, aux galeries d'allongement et travers-bancs, aux c tégorie engl descenderies, à l'échantillonnage de la roche et à l'évacuation des eaux.

Remarque : Les chiffres ont été arrondis.

TABLE 16b. DEPOSIT APPRAISAL ACTIVITY,[1] BY PROVINCE AND TERRITORY, 2001

	Drilling (Surface and Underground)						Geophysical										
	Diamond		Other														
Province/Territory	Metres	Cost	Metres	Cost	Geochemical	Geology	Ground	Airborne	Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	7	1 713	–	-	2	289	98	–	–	146	239	4 022	1 253	474	256	1 921	10 412
Nova Scotia	1	30	. . .	. . .	–	17	–	–	9	12	185	80	411	385	456	. . .	1 583
New Brunswick	10	1 900	–	–	–	300	–	–	–	–	–	–	–	–	–	–	2 200
Quebec	151	6 768	–	–	. . .	359	194	–	6 195	2 465	4 179	483	1 990	1 398	582	–	24 612
Ontario	60	6 224	–	–	179	1 437	192	–	5 740	73	828	72	422	1 362	241	–	16 769
Manitoba	34	2 144	–	–	–	10	27	–	242	–	3	–	101	236	–	5	2 768
Saskatchewan	–	–	–	–	–	–	–	–	–	3 527	1 918	–	–	5 476	1 002	–	11 923
Alberta	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–	–
British Columbia	21	1 257	–	–	137	884	–	–	–	57	424	168	233	171	206	182	3 739
Yukon	–	–	–	–	24	–	–	–	–	4	89	–	–	30	239	20	406
Northwest Territories	18	4 218	4	11 461	–	1 884	148	–	7 731	8 523	8 402	–	150	4 302	1 713	486	49 018
Nunavut	18	4 756	–	–	–	80	–	160	–	–	1 444	–	–	756	510	560	8 266
Total	321	29 010	4	11 461	343	5 261	659	160	19 917	14 806	17 710	4 824	4 580	14 588	5 204	3 175	131 697
Percentage of grand total	n.a.	22.0	n.a.	8.7	0.3	4.0	0.5	0.1	15.1	11.2	13.4	3.7	3.5	11.1	4.0	2.4	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed; n.a. Not applicable.

(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.

Note: Numbers may not add to totals due to rounding.

TABLE 16c. EXPLORATION PLUS DEPOSIT APPRAISAL ACTIVITIES, (1) BY PROVINCE AND TERRITORY, 2001

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	48	6 891	1	16	841	4 403	1 580	473	1 470	2 439	258	4 024	1 255	2 548	290	1 954	28 442
Nova Scotia	4	226	1	67	92	297	160	–	61	37	207	80	446	603	503	41	2 819
New Brunswick	51	4 683	12	588	342	1 682	437	139	124	111	14	–	-	1 305	35	1	9 459
Quebec	497	33 883	. . .	20	2 059	14 898	8 458	5 742	13 269	6 309	4 347	490	2 036	10 147	1 099	190	102 947
Ontario	481	37 135	10	10 415	5 164	21 738	7 518	6 500	10 905	2 469	978	122	680	8 395	456	1 164	113 640
Manitoba	134	13 004	3	120	1 466	2 202	2 739	1 843	1 208	1 580	4	–	101	4 306	23	70	28 667
Saskatchewan	88	11 643	11	4 010	356	1 173	3 517	580	2	5 239	2 068	–	–	7 908	1 026	12	37 535
Alberta	7	1 317	31	718	139	201	271	127	–	162	157	–	–	1 329	15	16	4 453
British Columbia	204	12 204	–	–	1 760	5 574	853	153	1 058	928	581	240	263	3 092	1 859	572	29 137
Yukon	12	2 791	–	–	691	2 379	262	122	561	125	89	–	–	356	384	47	7 807
Northwest Territories	45	14 805	11	16 870	4 144	5 679	3 085	5 468	7 746	9 282	8 494	32	253	8 157	1 747	884	86 645
Nunavut	109	28 325	7	3 192	3 440	9 260	1 930	2 535	2 823	484	1 469	–	–	6 126	899	835	61 318
Total	1 679	166 905	87	36 016	20 495	69 485	30 810	23 682	39 227	29 165	18 665	4 988	5 034	54 272	8 338	5 787	512 869
Percentage of grand total	n.a.	32.5	n.a.	7.0	4.0	13.5	6.0	4.6	7.6	5.7	3.6	1.0	1.0	10.6	1.6	1.1	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed; n.a. Not applicable.

(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.

Note: Numbers may not add to totals due to rounding.

TABLE 16d. MINE COMPLEX DEVELOPMENT ACTIVITY, (1) BY PROVINCE AND TERRITORY, 2001

Province/Territory	Drilling (Surface and Underground)				Geochemical	Geology	Geophysical		Rock Work (2)	Other Field Costs	Engineering Studies	Economic Studies	Pre- or Production Feasibility Studies	Mineral Lease and Head Office	Environment	Land Access	Grand Total
	Diamond		Other														
	Metres	Cost	Metres	Cost			Ground	Airborne									
	(000)	($000)	(000)	($000)							($000)						
Newfoundland and Labrador	2	59	109	2 772	–	141	–	–	16 197	3	–	–	–	1 044	30	–	20 247
Nova Scotia	6	212	152	212	–	23	–	–	6 951	1	116	–	–	108	254	70	7 946
New Brunswick	20	5 898	16	9 302	33	47	–	–	28 026	10 282	–	–	–	1 391	3 062	48	58 069
Quebec	182	6 269	38	2 283	396	2 358	20	–	162 276	30 493	13 980	–	43	32 903	18 681	47	269 727
Ontario	423	24 003	232	5 556	283	4 501	378	245	105 174	382	1 525	2	–	5 471	8 696	–	156 197
Manitoba	148	7 201	–	–	428	459	264	–	53 436	98	608	–	4	1 952	215	–	64 661
Saskatchewan	15	3 483	50	6 209	–	15	81	–	3 597	1 086	247	–	663	5 554	5 184	59	26 158
Alberta	2	300	10	1 325	–	67	–	–	27 921	152	919	55	111	5 523	10 427	44	46 844
British Columbia	89	3 697	624	4 419	793	1 530	187	–	14 805	283	1 198	45	60	6 961	2 212	72	38 262
Yukon	1	95	–	–	–	–	–	–	–	–	26	–	–	10	–	–	132
Northwest Territories	–	–	1 192	23 986	–	456	–	–	60 068	13 038	4 532	–	–	17 376	7 604	4 464	131 503
Nunavut	7	410	–	–	29	184	–	–	8 859	–	275	–	–	417	1 527	12	11 714
Total	894	51 626	2 423	56 043	1 962	9 780	931	245	487 308	55 797	23 406	103	881	78 709	57 872	4 816	829 478
Percentage of grand total	n.a.	6.2	n.a.	6.8	0.2	1.2	0.1	. . .	58.7	6.7	2.8	. . .	0.1	9.5	7.0	0.6	100.0

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed; n.a. Not applicable.

(1) Includes on-mine-site plus off-mine-site activities. (2) Includes stripping, trenching, shaft work, drifts, cross-cuts, raises, declines, rock sampling and de-watering costs.

Note: Numbers may not add to totals due to rounding.

TABLE 17a. EXPLORATION PLUS DEPOSIT APPRAISAL (SURFACE DRILLING), (1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					(000 metres)				
Newfoundland and Labrador	26	15	3	–	3	2	–	–	48
Nova Scotia	–	2	. . .	–	1	3	–	–	5
New Brunswick	28	23	–	–	. . .	. . .	–	–	52
Quebec	190	128	–	–	5	5	4	–	331
Ontario	117	230	–	–	13	2	25	–	386
Manitoba	43	11	–	–	10	2	4	–	70
Saskatchewan	8	10	–	62	1	–	10	6	96
Alberta	–	. . .	–	–	–	–	7	12	19
British Columbia	52	125	–	–	6	6	–	15	204
Yukon	5	7	–	–	. . .	–	–	–	12
Northwest Territories	5	4	–	–	. . .	–	45	–	54
Nunavut	21	71	–	–	7	–	15	–	114
Total	494	626	4	62	46	19	109	33	1 394

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.

(1) Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.

Note: Numbers may not add to totals due to rounding.

TABLE 17b. EXPLORATION PLUS DEPOSIT APPRAISAL (UNDERGROUND DRILLING), (1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals					Nonmetals	Diamonds	Coal	Total
	Base	Precious	Iron	Uranium	Other				
					(000 metres)				
Newfoundland and Labrador	–	. . .	–	–	–	–	–	–	. . .
Nova Scotia	–	–	–	–	–	–	–	–	–
New Brunswick	6	4	–	–	–	–	–	–	10
Quebec	11	155	–	–	–	–	–	–	166
Ontario	28	70	–	–	7	–	–	–	104
Manitoba	51	15	–	–	–	–	–	–	67
Saskatchewan	2	–	–	–	–	–	–	–	2
Alberta	–	–	–	–	–	–	–	20	20
British Columbia	–	–	–	–	–	–	–	–	–
Yukon	–	–	–	–	–	–	–	–	–
Northwest Territories	–	–	–	–	–	–	–	–	2
Nunavut	–	2	–	–	–	–	–	–	2
Total	98	246	–	–	7	. . .	2	20	372

Source: Natural Resources Canada, from a federal-provincial-territorial survey of mining and exploration companies.
– Nil; . . . Amount too small to be expressed.

(1) Includes on-mine-site plus off-mine-site activities. Drilling includes diamond and other types of drilling.

Note: Numbers may not add to totals due to rounding.

TABLE 18a. EXPLORATION EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($ 000)				
Newfoundland and Labrador	9 393	4 337	1 766	32	1 904	598	–	–	18 030
Nova Scotia	14	207	62	–	275	678	–	1	1 236
New Brunswick	4 038	3 124	–	–	31	65	–	–	7 259
Quebec	39 177	29 386	–	209	872	1 238	7 453	–	78 335
Ontario	20 208	46 578	133	–	2 042	421	27 489	–	96 870
Manitoba	14 584	4 672	–	–	1 351	347	4 944	–	25 898
Saskatchewan	2 518	1 815	16	14 742	575	–	5 667	279	25 613
Alberta	8	355	–	31	–	–	2 533	1 527	4 453
British Columbia	5 815	13 616	. . .	–	1 303	1 874	–	2 789	25 398
Yukon	2 989	3 619	–	10	426	357	–	–	7 401
Northwest Territories	4 161	1 725	4	9	742	150	30 837	–	37 627
Nunavut	11 214	23 697	–	134	1 414	–	16 594	–	53 053
Total	114 119	133 131	1 981	15 166	10 934	5 727	95 516	4 597	381 173

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 18b. DEPOSIT APPRAISAL EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	6 377	501	233	–	2 938	363	–	–	10 412
Nova Scotia	178	54	–	–	108	1 244	–	–	1 583
New Brunswick	1 320	880	–	–	–	–	–	–	2 200
Quebec	8 544	13 390	–	–	2 532	146	–	–	24 612
Ontario	3 599	10 994	–	–	1 638	538	–	–	16 769
Manitoba	2 671	67	–	–	30	–	–	–	2 768
Saskatchewan	–	–	–	11 923	–	–	–	–	11 923
Alberta	–	–	–	–	–	–	–	–	–
British Columbia	1 312	932	–	–	71	537	–	887	3 739
Yukon	231	175	–	–	–	–	–	–	406
Northwest Territories	465	262	–	–	213	–	48 078	–	49 018
Nunavut	628	6 536	–	–	–	–	1 102	–	8 266
Total	25 324	33 791	233	11 923	7 530	2 829	49 180	887	131 697

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 18c. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES,(1) BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals Base	Precious	Iron	Uranium	Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	15 770	4 838	1 999	32	4 842	961	–	–	28 442
Nova Scotia	192	261	62	–	382	1 921	–	1	2 819
New Brunswick	5 358	4 004	–	–	31	65	–	–	9 459
Quebec	47 721	42 776	–	209	3 405	1 384	7 453	–	102 947
Ontario	23 806	57 572	133	–	3 680	959	27 489	–	113 640
Manitoba	17 255	4 740	–	–	1 381	347	4 944	–	28 667
Saskatchewan	2 518	1 815	16	26 664	575	–	5 667	279	37 535
Alberta	8	355	–	31	–	–	2 533	1 527	4 453
British Columbia	7 127	14 548	. . .	–	1 374	2 412	–	3 676	29 137
Yukon	3 221	3 794	–	10	426	357	–	–	7 807
Northwest Territories	4 626	1 986	4	9	955	150	78 916	–	86 645
Nunavut	11 842	30 232	–	134	1 414	–	17 696	–	61 318
Total	139 443	166 922	2 214	27 089	18 464	8 556	144 697	5 484	512 869

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.

– Nil; . . . Amount too small to be expressed.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Notes: Numbers may not add to totals due to rounding. The mineral commodity group for unspecified mineral commodities was pro-rated.

TABLE 18d. MINE COMPLEX DEVELOPMENT EXPENDITURES,[1] BY PROVINCE AND TERRITORY, BY MINERAL COMMODITY SOUGHT, 2001

Province/Territory	Metals Base	 Precious	 Iron	 Uranium	 Other	Nonmetals	Diamonds	Coal	Total
					($000)				
Newfoundland and Labrador	–	6 290	13 014	–	–	942	–	–	20 247
Nova Scotia	–	7	–	–	–	7 837	–	101	7 946
New Brunswick	32 225	21 483	–	–	–	4 381	–	–	58 089
Quebec	89 915	49 190	78 108	–	18 298	34 217	–	–	269 727
Ontario	43 105	110 360	–	–	467	2 265	–	–	156 197
Manitoba	44 865	18 605	–	–	237	955	–	–	64 661
Saskatchewan	2 848	2 000	–	6 005	–	12 849	–	2 455	26 158
Alberta	–	–	–	–	–	1 656	–	45 188	46 844
British Columbia	7 786	2 937	–	–	5 689	1 316	–	18 534	36 262
Yukon	44	88	–	–	–	–	–	–	132
Northwest Territories	–	7 570	–	–	974	–	122 959	–	131 503
Nunavut	1 779	9 935	–	–	–	–	–	–	11 714
Total	222 566	228 464	91 122	6 005	25 665	66 419	122 959	66 278	829 478

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.
– Nil.

(1) Includes on-mine-site plus off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 19. EXPLORATION PLUS DEPOSIT APPRAISAL EXPENDITURES [a] BY PROVINCE AND TERRITORY, BY TYPE OF COMPANY, 2001

Province/Territory	(1) Companies With a Producing Mine in Canada	(2) Affiliates of (1)	(3) Oil Companies	(4) Foreign Companies Excluding (3)	(5) Junior Companies and Prospectors	(6) Other Companies	(7) Total
				($000)			
Newfoundland and Labrador	6 291	14 850	–	28	7 157	116	28 442
Nova Scotia	199	–	15	–	2 606	–	2 819
New Brunswick	5 821	376	–	–	3 263	–	9 459
Quebec	50 189	2 978	–	–	30 035	7 235	102 947
Ontario	50 959	2 145	185	19 306	39 725	1 231	113 640
Manitoba	15 450	2 513	–	2 627	7 169	908	28 667
Saskatchewan	12 848	14 275	–	3 153	7 222	38	37 535
Alberta	1 561	1 393	–	–	1 500	–	4 453
British Columbia	10 170	103	322	5	18 318	219	29 137
Yukon	1 846	345	–	118	5 499	–	7 807
Northwest Territories	17 449	1 528	169	50 991	15 109	1 400	86 645
Nunavut	8 799	4 793	751	6 839	40 130	7	61 318
Total	181 580	45 297	1 442	95 665	177 733	11 153	512 869

Source: Natural Resources Canada, from a federal-provincial survey of mining and exploration companies.
– Nil.

(a) Includes on- and off-mine-site activities. Includes field work, overhead, engineering, economic and pre- or production feasibility studies, environmental and land access expenditures.

Note: Numbers may not add to totals due to rounding.

TABLE 20. GENERALIZED MODEL OF THE MINERAL RESOURCE DEVELOPMENT AND MINING PROCESS

PHASE	MINERAL RESOURCE ASSESSMENT	MINERAL EXPLORATION					MINERAL DEPOSIT APPRAISAL				MINE COMPLEX DEVELOPMENT	MINE PRODUCTION	ENVIRONMENTAL RESTORATION
		GRASS-ROOTS EXPLORATION											
	MRA	EX-1	EX-2	EX-3	EX-4	EX-5	DA-1	DA-2	DA-3	DA-4	MCD	MP	ER
STAGE	Various surveys, research and synthesis.	Exploration planning.	Regional reconnaissance and surveys.	Prospecting and ground surveys of anomalies.	Verification of anomalies and showings.	Discovery and delimitation of a mineral deposit.	Mineral deposit definition.	Project engineering.	Project economics.	Feasibility study, production decision.	Mine development, construction of processing plant and infrastructure.	Production, marketing and renewal of reserves.	Mine complex closure and decommissioning, site restoration.
OBJECTIVES	Supply information and tools required to develop the mineral potential of the nation for economic benefit, in the perspective of sustainable development.	Select target commodities. Establish exploration objectives and strategies. Select target areas and sites. Acquire claims or permits if appropriate.	Seek anomalies of interest over wide areas by various survey methods. Select the more promising targets. Acquire claims or permits.	Confirm the presence, exact location and characteristics of anomalies. Acquire claims, leases and properties.	Investigate the cause of anomalies. Find mineral showings. Acquire additional claims, leases and properties.	Discover, delimit and interpret grade, quality and tonnage of a new mineral deposit. Determine if it constitutes a mineral resource of "potential economic interest" to justify more intensive and detailed work.	Define the limits, controls and internal distribution of grades, mineralogy and mineral processing characteristics of the deposit. Acquire all data required for project engineering and cost estimation.	Determine, in an iterative fashion, the design, plans, schedules, capital cost and operating cost estimates for all aspects of the project. Establish technical feasibility and costs thoroughly and rea-	Obtain all the information required and determine, based on corporate objectives parameters for the economic, financial and social-political evaluation of the project.	Diligently validate and integrate project data, interpretations, estimations, plans and evaluations to achieve MCD and production objectives. Decide on whether to undertake the mining project. Obtain permits and financing.	Complete mine development and construction on schedule and within budgets and specifications. Ensure efficient and timely mine complex start-up according to schedule, specifications and cash flow forecasts.	Achieve commercial production on schedule and meet cash flow forecasts and quantity and quality specifications. Achieve mine profitability and company survival in the perspective of sustain-able development.	Restore mine site, outside plant and infrastructure to environmentally acceptable condition. Ensure the future quality of the environment.
EVALUATION METHODS	Geoscientific, mineral and economic surveys, research, compilations and synthesis by governments, research institutes, universities and industry.	Metal and mineral market research. Review of geological and ore deposit information and of the legal, fiscal and socio-political context in various areas.	Remote sensing, aerial photography and airborne geophysics. Prospecting, geology and geochemistry. Appraisal, rating and selection of anomalies.	Ground, geological, geochemical and geophysical prospecting and surveys. Compilation, appraisal and selection of significant anomalies.	Geological mapping and other surveys. Trenching, drilling and sampling. Appraisal of results, recommendations for further work, and selection of new tar-	Stripping, trenching, mapping, sampling, drilling and down-hole geophysics. Initial mineral processing tests. Environmental and site surveys. Mineral resource estimation and inventory.	Detailed mapping, sampling and drilling on surface or from underground. Systematic mineralogy and mineral processing tests. Detailed environmental and site surveys. Pre-feasibility studies.	Pilot tests, engineering design and planning. Capital and operating costs for mining, mineral processing, infrastructure, environmental protection and restoration. Technical risk analysis. Prefeasibility studies.	Market, prices, product development and financial studies. Environmental, economic, financial, and socio-political risk analysis. Pre-feasibility studies.	Exhaustive due diligence review of all data, interpretations, plans and estimates. Evaluation of profitability, given the geological, technical, financial and qualitative risks, and the up-side	Project management methods in a quality assurance perspective. Training program for personnel and detailed start-up plan to meet the requirements of this demanding period.	Production management methods to ensure continuous quality and efficiency improvements. Exploration, deposit appraisal and development of new zones or deposits on-mine-site and off-mine-site.	Mine closure and decommissioning. Environmental restoration and monitoring.
RESULTS	Maps, data bases, tools and models.	Exploration projects.	Regional anomalies.	Local anomalies.	Mineral showings.	Mineral deposit.	Deposit appraisal project.			Mining project.	Mining complex.	Mineral production.	Restored site.
MINERAL INVENTORY	UNDISCOVERED MINERAL POTENTIAL					INFERRED RESOURCE	DELIMITED MINERAL RESOURCE				MINERAL RESERVE		
	SPECULATIVE			HYPOTHETICAL			INDICATED	INDICATED AND MEASURED			PROVEN AND PROBABLE		
ESTIMATION ERROR (targeted margin of error of tonnage/grade estimates at the 90% confidence level)						± 100%	± 50%	Indicated: ± 50 to ± 30% Measured: ± 20 to ± 10% (often several sample grid dimensions are used in each category)			Proven (feasibility: ± 10%, mining: ± 5%)		
INVESTMENTS	Moderate	Low, but increasing multiple investments					Larger and increasing multiple investments				Very large industrial investment		Full compliance
RISK LEVEL	Low	Very high, but decreasing risk of failure and financial loss					High, but decreasing risk of failure				Moderate to low industrial risk		

Sources: Modified by D.A. Cranstone, A. Lemieux and M. Vallée, February 25, 1994, from M. Vallée, 1992, *Guide to the Evaluation of Gold Deposits*, CIM Special Volume 45, p. 4, and *SOQUEM Annual Report*, 1976-77, pp. 4 and 5. Revised by M. Vallée and G. Bouchard, January 2001.

Canadian Mineral Exploration and Discovery Analysis

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CANADA'S STANDING AS AN EXPLORATION TARGET

In 2000, exploration and deposit appraisal expenditures for the non-petroleum minerals in Canada totalled $496.7 million, down slightly from $504.3 million in 1999. The total for 2001 is $512.9 million. In 2001, Canada remained one of the world's top exploration targets (second after Australia) in terms of mineral exploration expenditures. The decline in Canadian exploration expenditures that has occurred in recent years is typical of a worldwide decline. The Metals Economics Group's (MEG) survey[1] indicates that the United States continued to hold third place in 2001, but that Chile and Peru, in declining order, are now close behind the United States, followed by Brazil. The relative rankings of the top three countries have remained unchanged since 1992 (Figure 1). Although the MEG study is the only one to look at exploration spending worldwide, it continues to not adequately account for exploration expenditures in countries such as China and the various countries that have resulted from the break-up of the former Soviet Union. This is because MEG surveys only exploration expenditures by the "Western" companies exploring in these countries (with the exception of exploration in Russia by Alrosa Diamond); therefore, its survey results continue to be indicative of only a small part of the exploration there. With China's mineral production at least seven times that of Canada, more than five times that of Australia, and more than 50% higher than that of the United States,[2] it is likely that the

Figure 1
Top Three Country Destinations of Mineral Exploration Capital from Worldwide Sources, 1976-2001

	Rank		
Year	First	Second	Third
2001	Australia	**Canada**	United States
2000	Australia	**Canada**	United States
1999	Australia	**Canada**	United States
1998	Australia	**Canada**	United States
1997	Australia	**Canada**	United States
1996	Australia	**Canada**	United States
1995	Australia	**Canada**	United States
1994	Australia	**Canada**	United States
1993	Australia	**Canada**	United States
1992	Australia	**Canada**	United States
1991	**Canada**	Australia	United States
1990	**Canada**	Australia	United States
1989	**Canada**	Australia	United States
1988	**Canada**	Australia	United States
1987	**Canada**	Australia	United States
1986	**Canada**	Australia	United States
1985	**Canada**	Australia	United States
1984	**Canada**	Australia	United States
1983	**Canada**	Australia	United States
1982	**Canada**	Australia	United States
1981	**Canada**	Australia	United States
1980	Australia	**Canada**	United States
1979	Australia	United States	**Canada**
1978	Australia	United States	**Canada**
1977	United States	**Canada**	Australia
1976	**Canada**	United States	Australia

Source: Natural Resources Canada, based on official Canadian and Australian statistics and the best available data for the United States.
Notes: Australian expenditures were 6.5% higher than those for Canada in 1983 and 3.3% higher in 1991; however, correcting the reported Australian totals for substantial mine development expenditures, which are not included in Canadian statistics, ranks Canada first in 1983 and 1991. Complete data are not available for the former Soviet Union and China.

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[1] Data gathered in 2001.
[2] Refer to "Canada's Rank in World Mining," *Canadian Minerals Yearbook*, 2000, Table 1, p. 63.6.

magnitude of China's exploration effort actually exceeds that of each of Australia, Canada and the United States. This may also be true of mineral exploration expenditures in Russia.

DIAMOND EXPLORATION HIGHLIGHTS

Exploration for diamonds continues on a substantial number of properties in Newfoundland and Labrador, Quebec, Ontario, Manitoba, Saskatchewan, Alberta, the Northwest Territories and Nunavut. A substantial number of additional diamondiferous kimberlites continue to be discovered in various parts of Canada, although it is not feasible to summarize all the results here. More work will be required to determine whether any of the more recent diamondiferous kimberlite discoveries will constitute viable orebodies.

Ekati Diamond Mine, Northwest Territories

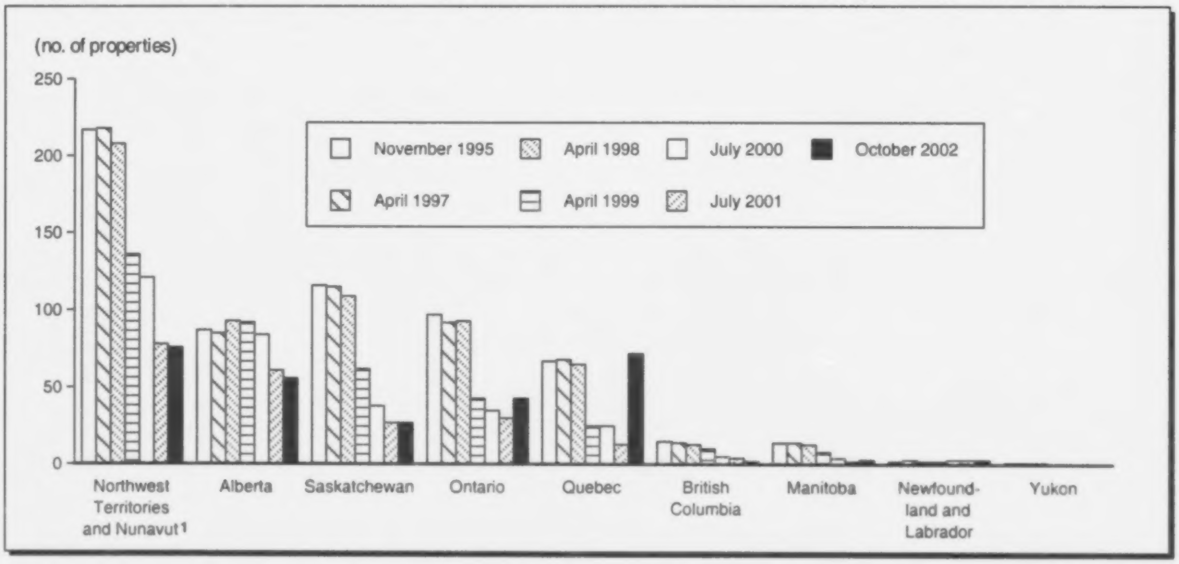
Although exploration of the Ekati property continued in 2001, it is no longer possible to obtain information concerning the results of that exploration, other than the information on reserves and resources that appeared in the *Description of Business and Financial Statements* of BHP Billiton Limited's 2001 annual report. In addition to resource data for the Panda, Misery, Koala, Fox and Sable pipes, these data (Table 1) include resource data for other deposits (Koala North, Beartooth, Pigeon, Jay and Lynx) that were not previously published.

Diavik Project, Northwest Territories

Exploration of the 267 000-ha Diavik property continued through 2001. According to the Aber Diamond Corporation 2001 annual report, a total of 58 kimberlite pipes (of Eocene age) have now been identified, many of which are known to be diamond-bearing. Two of these pipes were discovered in 2001. Two more pipes were sampled using various drilling techniques to begin the process of economic evaluation. Aber states that when the focus turns from construction and commissioning to the replenishment of mined ore reserves, the kimberlite pipes already discovered will be assessed while the search for new ones will continue. The 2002 exploration budget for the property is approximately $2.8 million.

Aber's annual report includes a mineral resource summary (Table 2). Of the overall resource of 138.1 Mct (in four deposits), 106.7 Mct have been assigned reserve status at an average value of US$64/ct (Table 3). Following a ramp-up period, annual production from the Diavik project is planned to be approximately 7 Mct.

Figure 2
Regional Distribution of Diamond Exploration and Deposit Appraisal Properties, 1995-2002



Source: Natural Resources Canada, based on *MIN-MET CANADA* database for 1995-97 and InfoMine database for 1998-2002, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

[1] In October 2002 there were 76 in the Northwest Territories and 25 in Nunavut for a total of 101. In July 2001 (2000), there were 78 (112) diamond exploration properties in the Northwest Territories and 10 (9) in Nunavut, for a total of 88 (121) properties in the two territories.

The production feasibility study indicates that production is to commence from Pipe A-154S early in 2003 as an open pit on the A-154S and A-154N kimberlites for the first 10 years. Pipe A-418 is to commence production in 2010 and continue to 2022. Pipe A-21 is to be mined between 2013 and 2019. Underground production from Pipe A-154 is forecast to occur between 2015 and 2019.

Gahcho Kué Project, AK Claims, Northwest Territories

The property at Kennady Lake is a joint venture of De Beers Canada Exploration Inc. (51%), Mountain Province Diamonds Inc. (44.1%) and Camphor Venture Inc. (4.9%). In 2001, De Beers carried out a $10 million bulk sampling program on the Hearne and 5034 pipes, which are the highest value of the 5034, Tuzo, Hearne and Tesla pipes. The taking of the bulk sample started in March 2001 and was completed in May 2001. The purpose of the program was to attempt to demonstrate that diamond revenues could be increased by the approximately 15% needed to advance the project to the feasibility stage. The 1665 ct of diamonds recovered from both pipes, together with the diamonds recovered from the 1999 bulk sample, were valued based on August 2001 values. The average revenue per carat for the 5034 pipe was US$65.50 for the combined 1999 and 2001 diamond parcels, compared to the adjusted US$69.30 for the 1999 bulk sample. Similarly, the average revenue per carat for the Hearne pipe is US$63.30 compared to the adjusted US$71.50 value for the 1999 bulk sample. Mountain Province indicates that the decrease in value for the 5034 and Hearne pipes are consistent with, or less than, the drop in rough diamond market values that has occurred since 1999.

A 9.9-ct diamond recovered from the 5034 pipe during the 2000/01 winter drilling program of high quality and top colour was valued by the Diamond Trading Company, in London, at US$60 000. A population of high-value diamonds (which includes the 9.9-ct diamond) exists among the diamonds recovered from the Hearne and 5034 pipes. This observation and additional follow-up analysis of these diamonds has led De Beers to the decision that more bulk sampling of the Hearne and 5034 pipes is needed. Mountain Province states that more high-quality diamonds need to be recovered so that their size frequency distribution can be more accurately determined. These high-quality diamonds, especially the larger ones, could have a large impact on the potential revenue per tonne, so the more accurately their frequency distribution can be determined, the greater will be the confidence in calculated revenue per tonne.

A drilling program consisting of the drilling of five 24-inch-diameter holes into the 5034 pipe, and four or five such holes into the Hearne pipe, commenced in mid-February 2002; the cost of this program was estimated at $10 million. The aim is to recover at least another 2000 ct of diamonds.

Exploration continues on other parts of the property and diamondiferous kimberlite sills were discovered in the MZ Lake area, 20 km northwest of Kennady Lake, during the winter of 1999/2000. Several more sills were discovered during the 2001/02 winter program. Five of them were determined to be diamondiferous.

Snap Lake Project, Northwest Territories

On February 26, 2002, De Beers Canada Mining Inc. filed an Environmental Assessment for its Snap Lake diamond project with the Mackenzie Valley Environmental Impact Review Board. Applications for a water licence and land use permit were filed on February 2, 2001. This will be De Beers' first mine outside of southern Africa. Once these processes are satisfactorily completed, the project will then move to the licensing phase under the Mackenzie Valley Land and Water Board. De Beers hopes that development and operation permits will be issued during the third quarter of 2003. If so, underground development and construction will start during 2003 with the main mobilization and construction planned for 2004. Production would begin in the fourth quarter of 2005, with full production of 3000 t/d to be achieved in the first half of 2006. Mining is planned over a period of 20+ years.

Winspear Diamonds Inc., the previous majority owner of the deposit, had stated that indicated ore reserves are 22.8 Mt at a mineable grade of 1.65 ct/t, with a further 20 Mt classified as inferred resources. The diamond value is about US$100/t. De Beers has not released any further information concerning ore reserves and resources.

Fort-à-la-Corne Area, Saskatchewan

The first kimberlite discovery in the vicinity of Fort-à-la-Corne (65 km east of Prince Albert) was made in 1988. Several companies have been exploring in the region since that time and approximately 90-100 kimberlites have been discovered. Some of them are exceptionally large in size; the largest is 1.6 km in diameter. A joint venture of De Beers Canada Exploration Inc. (42.5%), Kensington Resources Ltd. (42.5%), Cameco Corporation (5.5%), and UEM Inc. (carried 10% interest) has found a total of 69 individual kimberlite bodies on the joint-venture property, 34 of which contain macrodiamonds. The most favourable results, calculated by De Beers, are as follows:

- Kimberlite 122: 540 Mt modelled revenue (best fit) US$11/t; and

- Kimberlite 141: 395 Mt modelled revenue (best fit) US$28/t.

These diamond grades are based on very small diamond parcels, so their reliability is not likely to be high. A $4.79 million exploration program was carried out on the joint-venture property between June and October 2001. Exploration on the property continues.

Also in the Fort-à-la-Corne area, Shore Gold Inc. has been exploring the Star diamondiferous kimberlite since 1996. This kimberlite has a crater facies that is almost 4 km^2 in area with an average thickness of 88 m. A preliminary tonnage estimate is 500 Mt. Some 3.4 t of split core from 20 NQ and ore PQ drillholes yielded 1.244 ct of diamonds, or about 0.36 ct/t.

Subsequently, an 82.7-t sample, from a 24-inch-diameter hole drilled in October 2001 using a rotary bit, yielded 8.52 ct of diamonds, or 0.10 ct/t. The two largest stones recovered (both of them fragments of larger diamonds) weighed 0.64 and 0.40 ct.

Victor Project, Ontario

A 7000-t bulk sample taken by De Beers Canada Exploration Inc. from the Victor pipe (52°48'N, 83°53'W) has yielded C$94/t of diamonds for a kimberlite resource of 37 Mt. Another company source has stated that the value is C$100/t.

De Beers Canada has discovered 18 pipes on the property, 16 of which are diamondiferous, the largest of them called Victor. The Victor kimberlite comprises two pipes that coalesce at the surface and together have a surface area of 16 ha. The geology of the Victor kimberlite is complex, comprising both crater facies and hypabyssal facies kimberlite. The diamond grade within the kimberlite is highly variable and De Beers states that more work is required to accurately determine the value of the deposit and whether it is feasible to develop a diamond mine.

A pre-feasibility study will be undertaken to address the technical obstacles identified in a 2001 desktop study which concluded that, should a mine be developed, an open-pit operation would be most appropriate.

Activities in the pre-feasibility study will include: 1) an extensive drilling program to understand the geo-technical nature of the underlying clays, overburden, country rock and the hydrology around any future open pit; 2) seismic and electromagnetic surveys; 3) hydrology and geotechnical studies; 4) civil engineering test work and the construction of trial structures on top of the muskeg; 5) additional site infrastructure and design; 6) a number of technical investigations to optimize capital and working costs; and 7) environmental assessment and permitting work.

Jericho Project, Nunavut

In 1997, an underground bulk sample mined from the JD/OD kimberlite pipe of Tahera Corporation yielded 10 589 ct of diamonds (at a cutoff of 1 mm) from a representative 9400 t of kimberlite processed (of a 14 550-t bulk sample). A valuation by the Diamond Trading Company, the marketing arm of De Beers Consolidated Mines Limited, valued the diamonds recovered at an average of US$59.61/ct. In early 2000, re-evaluation of the diamonds resulted in a modelled valuation of US$74-$88/ct.

Tahera Corporation completed a feasibility study on the Jericho diamond project. It indicated that 3 Mct of diamonds could be produced over an eight-year open-pit/underground mine life with a base-case pre-tax rate of return of 34.3%. In early 2001, Tahera filed a formal project proposal with the relevant government authorities and submitted a draft Environmental Impact Statement.

An exploration joint venture with Kennecott Canada Exploration Inc. (wholly owned by Rio Tinto plc) has optioned Tahera's Rockinghorse property and, at Kennecott's option, the Jericho claims to Kennecott. Kennecott can earn a 62.5% interest by financing a mining project to production. Kennecott's goal is to discover more kimberlites and thus enhance the scale of the existing prospect. The agreement stipulates that Kennecott must make a development decision that includes the Jericho pipe within 24 months of September 2002 but cannot make a development agreement based solely on the Jericho pipe. Exploration of the property by Kennicott is continuing.

Jackson Inlet Project, Nunavut

At Jackson Inlet, near the north end of Baffin Island, Twin Mining Corporation collected mini-bulk samples of crater facies kimberlite from six pits on the Freightrain kimberlite. The total sample weight of 228.19 t yielded 46.208 ct of diamonds. A total of 30 stones weighed between 0.25 and 1.557 ct. The majority are reported to be high-quality, white transparent diamonds, but 4.376 ct of the transparent stones are yellow, pink and amber colours up to 0.870 ct in size. The five largest stones recovered from the kimberlite weigh 1.557, 0.936, 0.870, 0.867 and 0.809 ct.

In addition to the Freightrain kimberlite, the Cargo 1, Cargo 2 and Cargo 3 pipes have also been discovered. Exploration of the property for additional kimberlite pipes continues.

A three-year $37 million exploration program is planned for the property. In 2002, plans are to drill 40 152-mm (6-inch) vertical holes to a depth of 250-300 m and to take a bulk surface sample of 21 000 t.

Buffalo Head Hills Property, Alberta

In March 2000, the K252 kimberlite was discovered on a joint-venture property in the Buffalo Head Hills region. The property is owned by Ashton Mining of Canada Inc. (45%), Alberta Energy Company Ltd. (45%) and Pure Gold Minerals Inc. (10%). To December 31, 2001, a total of 36 kimberlites have been discovered in the region, 24 of which are diamondiferous.

The area of the K252 kimberlite is approximately 2 ha. In March 2001, a 22.8-t mini-bulk sample was taken from which 12.54 ct of diamonds larger than 0.8 mm in size were recovered, for a diamond content of 55.0 ct/100 t. The largest diamond was a 0.94-ct composite crystal and the second largest was a colourless 0.65-ct stone. The next six largest diamonds range from 0.17 to 0.28 ct.

Ashton's 2001 annual report states that the joint-venture partners plan a program of delineation drilling for early 2002 to determine the size and shape of the K252 kimberlite and, if warranted, will proceed with plans for the collection of a larger bulk sample.

Torngat Project, Quebec

Between September 2000 and April 2001, Twin Mining Corporation took a 342-t bulk sample from three sites on a diamondiferous kimberlite dyke that varies from 1 to 4 m and averages 1.2 m wide. A total of 13.120 ct of diamonds were recovered (0.038 ct/t). The largest diamonds weigh 0.685, 0.566, 0.279, 0.271 and 0.199 ct.

The Torngat property (327 km^2 in area) is characterized by five kimberlite dyke systems with a length of approximately 37 km. The most continuous and widest system observed to date is that made up of the Torngat 1 and Pita dykes, which average 1.45 m wide over an estimated strike length of more than 23.2 km.

Exploration of the property continues in 2002.

Otish Mountains, Quebec

Ashton Mining of Canada Inc. and SOQUEM INC. (50-50 joint-venture partners) have discovered six diamondiferous kimberlite bodies on their Foxtrot property in the Otish Mountains region. A 2.4-t sample collected from four 4.8-cm-diameter core holes in the Renard 2 kimberlite yielded a 1.69-ct parcel of diamonds larger than 0.8 mm, for an implied grade of 0.693 ct/t. The five largest diamonds recovered range in size from 0.1 to 0.16 ct. Exploration of the property continues.

Regional Distribution of Diamond Exploration and Deposit Appraisal Properties

Figure 1 (last updated in October 2002) demonstrates the significant increase in the number of diamond properties in Quebec that has resulted from the discovery of diamondiferous kimberlites in the vicinity of the Otish Mountains. There has also been some increase in the number of diamond properties in Ontario, presumably because it has become evident that the Victor kimberlite represents a potential diamond mine.

There has been a 35% increase in the total number of diamond properties in Canada, from 228 properties in July 2001 to 307 properties in October 2002.

RECENT DISCOVERY SUCCESS IN CANADA

It is becoming increasingly difficult to be aware of all the mineral deposit discoveries being made in Canada. In recent years, the Canadian mining newspaper, *The Northern Miner*, has become increasingly focussed on mining and exploration activities in other countries, so it provides little or no information concerning many of the discoveries made in Canada, especially the smaller ones. This makes it much more difficult to compile deposit discovery listings such as that presented in Table 4 (Canadian Mineral Discoveries, 1990-2001). This listing is undoubtedly still incomplete.

Table 4 includes some deposits for which the owner of the property says that a deposit has been discovered but has not yet provided a tonnage and grade. It also includes some exploration properties on which the drillhole intersections that have been reported are so attractive that it would appear that a deposit discovery has been made, but it is not yet certain that all such properties actually do contain deposits.

Perusal of Table 4 for the types of deposits discovered in Canada over the period 1990-2002 clearly demonstrates that diamond deposit discoveries constitute the major portion of the contained values discovered, followed by nickel-copper-cobalt-precious metal deposits at Voisey's Bay in the Labrador portion of the province of Newfoundland and Labrador, in Quebec's Raglan nickel belt and in the Sudbury District of Ontario. The importance of the diamond discoveries is illustrated by the $870 million value of the diamonds produced from the Ekati diamond operation in 2001. The value of Canada's diamond production could increase by as much as $700 million per year when the Diavik operation, which comes into production in early 2003, reaches full production of about 7 Mct/y following a two-year ramp-up period, and could increase further with production from the Snap Lake deposit in 2005-06.

Additional Canadian diamond mines may be developed from some of the other diamond deposits that have been discovered in Canada between 1990 and the present time. Canada seems likely to soon become the world's third-largest producer of diamonds in terms of value, after Russia and Botswana.

The world-class Voisey's Bay nickel operation, currently scheduled for production in 2006, will lead to a major increase in Canadian nickel production and to a major increase in the value of mineral production in the province of Newfoundland and Labrador.

The large, new, deep Triple 7 orebody at Flin Flon, Manitoba, discovered by Hudson Bay Mining and Smelting Co. Limited in 1996 and scheduled to produce in 2004, is open both laterally and at depth, and together with other discoveries and likely future discoveries in the Flin Flon-Snow Lake region, can be expected to prolong the life of the company's mining and smelting operations.

Notes: (1) Information in this review was current as of January 31, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. EKATI DIAMOND MINE MINERAL RESOURCE (1) SUMMARY

	Resource Category	Tonnage	Grade
		(Mt)	(ct/t)
Panda kimberlite (open-pit) (2)	Measured	4.0	1.0
	Indicated	2.1	1.0
Panda kimberlite (underground)	Measured	1.4	1.0
	Indicated	1.0	1.0
Misery kimberlite (open-pit)	Measured	5.2	4.3
	Indicated	1.2	4.5
Koala kimberlite (open-pit)	Measured	6.3	1.0
	Indicated	2.3	0.9
Koala kimberlite (underground)	Measured	3.2	0.8
	Indicated	3.6	1.1
Fox kimberlite (open-pit)	Measured	8.0	0.3
	Indicated	8.2	0.4
Sable kimberlite	Measured	12.0	0.9
	Indicated	4.0	0.9
Koala North kimberlite (open-pit)	Measured	0.1	0.5
Koala North kimberlite (underground)	Inferred	11.2	0.5
Beartooth kimberlite	Measured	1.1	1.1
	Inferred	0.2	1.0
Pigeon kimberlite (open-pit)	Measured	3.1	0.5
	Indicated	1.1	0.5
Jay kimberlite	Indicated	17.0	2.1
Lynx kimberlite	Measured	1.1	0.8
	Indicated	0.3	0.8

Source: *Description of Business and Financial Statements* in BHP Billiton Limited's 2001 annual report.

(1) Total mineral resources (including ore reserves) as of the end of June 2001.

(2) The Panda mine commenced production in 1998 and the Misery mine in December 2001.

TABLE 2. DIAVIK DIAMONDS PROJECT, MINERAL RESOURCE SUMMARY

Pipe	Resource Type	Tonnage	Grade
		(Mt)	(ct/t)
A-154S	Measured	8.2	5.6
	Indicated	3.2	5.1
	Inferred	0.6	3.2
A-154N	Measured	–	–
	Indicated	6.9	2.6
	Inferred	4.6	2.1
A-418	Measured	4.9	3.4
	Indicated	3.6	3.8
	Inferred	0.6	3.5
A-21	Measured	–	–
	Indicated	4.4	3.1
	Inferred	0.6	0.7
Total resources		37.4	3.7

Source: Aber Diamond Corporation *2001 Annual Report*.
– Nil.
Notes: Resource summary to -5 m elevation at a nominal cut off of 1-mm-square mesh. Totals may not add due to rounding.

TABLE 3. DIAVIK DIAMONDS PROJECT, ORE RESERVE SUMMARY

Open-Pit and Underground Mining	Proven			Probable			Proven and Probable		
	(Mt)	(ct/t)	(Mct)	(Mt)	(ct/t)	(Mct)	(Mt)	(ct/t)	(Mct)
A-154S	8.5	5.3	45.3	3.3	4.9	15.9	11.7	5.2	61.2
A-154N	–	–	–	1.3	3.5	4.5	1.3	3.5	4.5
A-418	5.1	3.2	16.4	3.6	3.6	12.8	8.7	3.4	29.3
A-21	–	–	–	4.0	3.0	11.7	4.0	3.0	11.7
Total reserves	13.5	4.6	61.7	12.2	3.7	44.9	25.7	4.2	106.7

Source: Aber Diamond Corporation *2001 Annual Report* (from bankable feasibility study).
– Nil.
Note: Totals may not add due to rounding.

TABLE 4. CANADIAN MINERAL DEPOSIT DISCOVERIES MADE IN THE YEARS 1990-2001 INCLUSIVE

Province or Territory/ Project Name	Discovery Year	Remarks
NEWFOUNDLAND AND LABRADOR		
Hammerdown deposit	1990	Discovered by Noranda Inc. and Major General Resources Ltd. 464 000 t grading 17.48 g/t Au.
Lochinvar deposit	1990 or 1994	Major General Resources Ltd. Discovered by Noranda Inc. 570 000 t of 7% Zn equivalent (Zn, Pb, Ag, Au).
Beaver Brook deposit	1992	Owned by Roycefield Resources Ltd. 2 401 550 t grading 4.08% Sb (at a 1.5% Sb cutoff grade). Deposit expected to be much larger.
Long Lake deposit	1994	Discovered by Noranda Inc. 970 000 grading 10.9% Zn, 1.7% Cu, 1.3% Pb, 33.3 g/t Ag and 0.8 g/t Au. Open along strike and at depth.
Voisey's Bay deposit	1994	Owned by Inco Limited. Discovered by Diamond Fields Resources Inc. Proven reserve 31 Mt grading 2.88% Ni, 1.69% Cu and 0.14% Co. Indicated resource 97 Mt grading 1.29% Ni, 0.61% Cu and 0.08% Co. Inferred resource 14 Mt grading 1% Ni, 0.7% Cu and 0.06% Co.
Orion Zone	1995	Discovered by Major General Resources Ltd. 270 000 t averaging 7.0 g/t Au.
Ryans Pond	1999	Discovered by Inco Limited. Located 3 km ESE of the Eastern Deeps deposit. Drillhole intersection of 29.5 m grading 1.3% Ni, 0.6% Cu and 0.04% Co. Tonnage and grade not published.
NOVA SCOTIA		
Shubenacadie River heavy mineral sands	1998	Titanium Corporation Inc. 331 Mt of titanium-zircon-bearing mineral sands with an average heavy minerals content of 1.94%.
NEW BRUNSWICK		
Mount Fronsac deposit	2001	Discovered by Noranda Inc. 1.2 Mt averaging 7.65% Zn, 2.18% Pb, 0.14% Cu, 40.3 g/t Ag and 0.40 g/t Au.
QUEBEC		
Chevrier deposit	1990	GeoNova Explorations Inc. and Inmet Mining Corporation. 3.5 Mt averaging 5.10 g/t Au.
Bell Allard mine	1993	Discovered by Noranda Inc. Reserves before production began: Proven - 983 000 t averaging 1.06% Cu, 11.79% Zn, 34.5 g/t Ag and 0.8 g/t Au; Probable - 2 552 000 t averaging 1.57% Cu, 14.46% Zn, 44.2 g/t Ag and 0.7 g/t Au.
Fenelon deposit	1993	Fairstar Explorations Inc. and International Taurus Resources Inc. Discovered by Cyprus Canada. Indicated resource (in 1998): 252 000 t grading 14.2 g/t Au. (A bulk sample taken in 2001 produced 4339 oz of Au.)
Caber deposit	1994	Tango Mineral Resources Inc. Discovered by BHP Minerals Canada Ltd. Indicated and inferred resource: 800 000 t grading 10% Zn, 0.6% Cu and 11 g/t Ag.
Comtois deposit	Between 1994 and 1997	Maude Lake Exploration Limited. Discovered by Brian Osborne and Cameco Gold Inc. Indicated resource: 1 813 086 t grading 4.5 g/t Au (1 g/t cutoff) including 695 485 t at 9.05 g/t Au (4 g/t cutoff).

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Duquesne West deposit	1994	Globex Mining Enterprises Inc. (50%) and an unspecified company. Discovered by Santa Fe Canadian Mining Limited. Drill-indicated mineral inventory: Fox zone - 729 500 short tons grading 0.31 oz/ton Au; Shaft zone - 276 500 short tons grading 0.20 oz/ton Au; South zone - 183 000 short tons grading 0.49 oz/ton Au; and East Stringer zone - 444 000 short tons grading 0.13 oz/ton Au.
Caber North deposit	1995	Tango Mineral Resources Inc. Discovered by BHP Minerals Canada Ltd. Inferred resources: 2.1 Mt averaging 4.1% Zn, 1.5% Cu and 19 g/t Ag.
Sept-Îles apatite-ilmenite-magnetite deposit	1995	Owned by SOQUEM Inc. and Norsk Hydro. 104 Mt grading 8.54% TiO_2 and 8.54% P_2O_5, or 200 Mt grading 8.54% TiO_2 and 6.2% P_2O_5.
Tortigny deposit	1995	Discovered by Noranda Inc. 531 000 t grading 6.49% Zn, 3.59% Cu, 85.23 g/t Ag and 0.43 g/t Au.
Falconbridge Raglan Project		
New lenses at Katiniq	1990s	Discovered by Falconbridge Limited. 670 000 t averaging 3.00% Ni and 0.80% Cu.
Unnamed deposit, 4 km east of Katiniq	1995	Discovered by Falconbridge Limited. 814 000 t grading 3.36% Ni and 0.83% Cu.
Katiniq	1995	Discovered by Falconbridge Limited. A new lens containing 400 000 t grading 3.36% Ni and 0.83% Cu.
East Lake	1998	Discovered by Falconbridge Limited. 1 153 000 t grading 3.71% Ni, 1.09% Cu and 0.08% Co.
Lens 1040 orebody	1998	Discovered by Falconbridge Limited. Diluted probable reserves: 1.26 Mt grading 3.23% Ni and 0.95% Cu.
Lens 441, 300 m east of Lens 1040	1998	Discovered by Falconbridge Limited. Undiluted indicated resources: 500 000 t grading 2.37% Ni and 0.64% Cu.
West Boundary property	1998	Discovered by Falconbridge Limited near the Spoon zone. 480 000 t of unstated grade.
Zone 13-14	1998?	Discovered by Falconbridge Limited. 395 000 t averaging 1.90% Ni and 0.51% Cu. Located 9 km east of Katiniq.
Zone 3	1999	Discovered by Falconbridge Limited, southwest of a zone outlined in 1996 and 1997 at Zone 3. 295 000 t grading 3.3% Ni and 0.96% Cu, located 170-280 m below surface on a previously unexplored horizon that appears to extend across a significant portion of the company's Raglan property.
Lens C West Boundary zone	2001	Discovered by Falconbridge Limited. 560 000 t averaging 2.49% Ni and 0.81% Cu.
La Grande Sud deposit	1997	Virginia Gold Mines Inc. Mineral inventory 3 115 266 t averaging 2.6 g/t Au and 0.3% Cu, at a cutoff grade of 1.50 g/t Au. Open at depth.
Gemini deposit	1998	Cancor Mines Inc. Zinc-rich massive sulphide zone: 1 300 000 t of 8.26% Zn equivalent; Copper zone: 700 000 t of 3.01% Cu equivalent; "A" zone: 3 130 000 t grading 1.09 g/t Au and 3.7g/t Ag (may be open in all directions).
Lac Rocher deposit	1998	Discovered by Nuinsco Resources Limited. Estimated geological inventory: 3 Mt averaging approximately 0.5% Ni and 0.2% Cu.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Lapa deposit	1999?	Agnico-Eagle Mines Limited. Discovered by Breakwater Resources Ltd. A gold deposit. Resource estimate not yet released.
Porphyry Mountain deposit (at Gaspé Copper)	1999	Discovered by Noranda Inc. 206 Mt grading 0.7% Cu.
Sigma Mine open-pit orebody	1999	Owned by McWatters Mining Inc. Proven and probable reserves of 23 351 000 t averaging 2.96 g/t Au. Inferred resources: 11 504 000 t averaging 4.9 g/t Au.
Perseverence deposit (at Matagami)	2000	Discovered by Noranda Inc. Mineral resource: 5 Mt averaging 16.8% Zn, 1.3% Cu, 34 g/t Ag and 0.4 g/t Au. Includes Perseverence, Perseverence West and Equinox zones.
Haut Plateau area deposit	2001	Owned by Falconbridge Limited and Rockwell Ventures Inc. Discovered by Falconbridge Limited. A nickel-copper-cobalt discovery. Exploration in progress. Deposit tonnage and grade unknown.
De Maures deposit	1990s	350 000 t grading 7.84% Zn, 1.35% Cu and 22.31 g/t Ag.
ONTARIO		
GAZ deposit	Early 1990s	Wolfden Resources Inc. Discovered by Placer Dome Inc. A gold deposit. Tonnage and grade have not yet been released.
Victor deposit	1990	Discovered by Inco Limited. About 36 Mt averaging 2% Ni and 6% Cu.
McCreedy East deposit	1990	Discovered by Inco Limited. Initial mining phase: 15 Mt grading 1.44% Ni and 4.32% Cu (the deposit is considerably larger).
Nickel Rim Deep deposit	1992	Discovered by Falconbridge Limited. An extension of the Victor deposit on the adjacent Falconbridge property. 1.6 Mt averaging 1.58% Ni, 10.13% Cu (using a cutoff grade of 0.50% Ni), or 0.5 Mt averaging 4.13% Ni and 25.53% Cu (using a cutoff grade of 1.50% Ni).
Kyle #1 kimberlite	1994	Spider Resources Inc. 14.5 Mt based on 18 drillholes and a 6.22-t bulk sample, estimated to contain 0.60 ct/t of diamonds.
Kyle #3 kimberlite	1995	Discovered by KWG Resources Inc. and Spider Resources Inc. 10.9 Mt of dyke-like kimberlite with an average width of 25 m, traced by drilling over a strike length of 450 m. Average grade of nine holes is 0.92 ct/t of diamonds over a 6-m section in each hole.
#17 Gold zone	1995 or 1996	Discovered by Nunisco Resources Limited. 25.2 Mt grading 1.37 g/t Au.
Onaping Depth deposit	1996	Discovered by Falconbridge Limited. Indicated resource: 14.8 Mt of 2.52% Ni, 1.15% Cu and 0.06% Co. Inferred resource: 1.2 Mt of 3.61% Ni, 1.21% Cu and 0.07% Co.
#34 Nickel zone	1996	Discovered by Nuinsco Resources Limited. Strike length 350 m; weighted average grade of 1.98% Ni, 1.65% Cu, 0.09% Co, 2.35 g/t Pt, 5.94 g/t Pd, 1.59 g/t Au and 22.5 g/t Ag (based on only four drillholes), or drill-indicated resource with a metal content valued in the order of of $425/t based on subsequent drilling.
Timmins deposit	1996	Holmer Gold Mines Limited. 1.4 Mt grading 9 g/t Au.
Big Whopper petalite deposit	1997	Discovered by Avalon Ventures Ltd. 11.6 Mt averaging 1.34% Li_2O, of which 5.6 Mt average 1.41% Li_2O.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Big Mack pegmatite deposit	1997	Owned by Emerald Fields Resources Corporation, adjacent to the Big Whopper deposit. An ellipisoidal pegmatite exposed at surface for a 125-m strike length and 30-m width. A 5-t bulk sample yielded a Li_2O grade of 4.85%. Resources include 300 000+ t of unspecified grade, plus another zone of about 200 000 t.
Kelly Lake deposit	1997	Discovered by Inco Limited. 10.5 Mt grading 1.77% Ni, 1.34% Cu and 3.69 g/t PGM.
Mineralized zone 1800 m north of Copper Cliff South mine shaft	1997	Discovered by Inco Limited. Tonnage and grade have not yet been released. A representative sample taken in 1998 graded 4.5% Ni and 2.2% Cu over a width of 14 m.
Norman West deposit	1997	Discovered by Falconbridge Limited. Undiluted inferred resources: 7.6 Mt of 1.59% Ni and 1.28% Cu.
Victor kimberlite	1997	Discovered by De Beers Canada Exploration Inc. 36 Mt containing C$94/t of diamonds (another De Beers source says the diamond content is valued at C$100/t).
Frazer-Morgan zone	1998 or earlier	Discovered by Falconbridge Limited. Located 1.5-2 km southeast of the Fraser shaft. Undiluted inferred resources: 1 780 000 t grading 1.73% Ni and 0.49% Cu at a depth of 1450 m.
Boswell Township deposit	1998	Discovered by Falconbridge Limited. Located 13.5 km east of the Strathcona mill. Undiluted inferred resources: 678 000 t of 1.58% Ni and 0.71% Cu (the drill intersections are between 30 and 100 m below surface).
Potential discovery at Sudbury	1999	Owned by Falconbridge Limited. Located 8 km NW of the Lockerby mine and 3 km west of the Creighton mine. A surface exploration hole intersected 33.4 m averaging 2.6% Ni and 0.8% Cu at a depth of 436 m. According to Falconbridge, the estimated true thickness of the zone is approximately 18 m.
Pump Lake deposit	1999	Discovered by Inco Limited. 3.5 Mt grading 1.4% Ni, 1.0% Cu and 1.5 g/t Pt + Pd + Au. Further drilling is expected to increase tonnage (from a January 18, 2001, Inco press release).
Totten Deep deposit	1999	Discovered by Inco Limited. 10.1 Mt grading 1.50% Ni, 1.97% Cu and 4.8 g/t Pt + Pd + Au.
River Valley deposit (Dana Lake and Lismer Ridge areas)	2000	Discovered by Pacific Northwest Capital Corp. Measured and indicated resources: 18 Mt grading 0.06 g/t Au, 0.34 g/t Pt, 1.02 g/t Pd, 0.02% Ni and 0.1% Cu. Inferred resources: 5.8 Mt grading 0.05 g/t Au, 0.29 g/t Pt, 0.82 g/t Pd, 0.02% Ni and 0.09% Cu.
Nickel Rim South deposit	2001	Discovered by Falconbridge Limited. Located 2.7 km north of the Sudbury airport. 4.6 Mt grading 2.17% Ni, 4.90% Cu, 2.60 g/t Au, 3.12 g/t Pt, 3.66 g/t Pd and 18.56 g/t Ag.
MANITOBA		
McBratney Lake		FNX Mining Co. Inc. PGM mineralization discovered in 1991 by Hudson Bay Exploration & Development Company Limited. Drill intersection of 40 ft grading 10.65 g/t Pt + Pd. Redrilled by Fort Knox Gold Resources Inc. in 2000. Drill intersection of 16.8 m grading 8.9 g/t Pd, 1.8 g/t Pt, 1.1% Cu and 0.6% Ni. Additional drilling was planned for the fall of 2001 but no further information has been released.
Pipestone ilmenite deposit	1992	Gossan Resources Limited. 685 Mt grading 8.37% ilmenite, 17.9% magnetite and 0.28% V_2O_5.
Photo Lake mine	1993	Discovered by Hudson Bay Mining and Smelting Co., Limited. Mineable reserves prior to commencement of mining: 533 623 t averaging 4.5% Cu, 6% Zn, 33 g/t Ag and 4.7 g/t Au. The deposit has been mined out, but the tonnage and grade produced have not been published.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Pipe #1 Deep deposit	1994	Discovered by Inco Limited. 4 Mt averaging 2.32% Ni and minor Cu.
William Lake	pre-1996	Discovered by Falconbridge Limited. Falconbridge has been doing extensive drilling at William Lake for several years (William Lake is located on the southwest extension of the Thompson Nickel Belt) and appears to have discovered a nickel deposit or deposits, including the W-22 deposit. Tonnage and grade data have not been released.
Triple 7 deposit, Flin Flon	1996	Discovered by Hudson Bay Mining and Smelting Co., Limited (currently being developed for production). 14.2 Mt averaging 2.53% Cu and 5.09% Zn plus unspecified Au and Ag. Deposit open laterally and at depth.
SASKATCHEWAN		
Konuto Lake mine	1994	Discovered by Hudson Bay Mining and Smelting Co., Limited. Mineable resources at January 1, 1999 (prior to production): 1 550 159 t grading 4% Cu, 1.20% Zn, 8.35 g/t Ag and 1.84 g/t Au.
Star kimberlite	1996	Discovered by Shore Gold Inc. Contains 500 Mt. Samples of kimberlite core have given an estimated grade of 31.2 ct/100 t. The largest stone weighed 0.04 ct. An 82.7-t sample yielded 8.52 ct of diamonds, or 10.3 ct/100 t. The largest stones were fragments weighing 0.64 and 0.4 ct.
La Roque claims	1999	Cameco Corporation. Three drillholes have intersected 6.95% U over 3.6 m, 25.36% U over 7.0 m, and 16.2% U over 2.5 m. Exploration is currently suspended; no further drilling has been done.
122 kimberlite, Fort-à-la-Corne area	1999	Discovered by De Beers Canada Exploration Inc., Kensington Resources Ltd., Cameco Corporation and UEM Inc. 540 Mt with a diamond content valued at US$11/t. A 328-t sample yielded 5.3 ct/100 t. Six diamonds were larger than 0.5 ct with the two biggest stones weighing 1.53 and 1.08 ct.
141 kimberlite, Fort-à-la-Corne area	1999	Discovered by De Beers Canada Exploration Inc., Kensington Resources Ltd, Cameco Corporation and UEM Inc. 395 Mt with a diamond content valued at US$28/t. The largest diamond recovered weighs 3.35 ct.
Millenium deposit	2000	Discovered by Cameco Corporation (30%), UEM Inc. (23.6%), Cogema Resources Inc. (23.6%) and JCU (Canada) Ltd. (30%). A uranium deposit 600 m below surface, located 40 km north of Key Lake. Tonnage and grade have not been released.
ALBERTA		
Pelican River heavy minerals deposit	1999	New Blue Ribbon Resources Ltd. 14.4 Mt with a total heavy minerals content of between 900 000 t and 1 200 000 t. The heavy minerals consist of 21-24% rutile, 33-36% ilmenite and 15-18% magnetite. Estimated values of heavy mineral products: magnetite, $60/t (for coal separation); and rutile concentrate, US$550-$870/t.
K-252 kimberlite	2000	Discovered by Ashton Mining of Canada Inc. A 22.8-t mini-bulk sample yielded 0.55 ct/t (including 8 macrodiamonds 0.17-0.94 ct in weight), but the kimberlite intrusion appears to be small.
BRITISH COLUMBIA		
Kemess South mine	1990	Discovered by El Condor Resources Ltd. and St. Philips Resources Ltd. (?) 250 Mt averaging 0.22% Cu and 0.6 g/t Au.
Kemess North deposit	1990	Discovered by El Condor Resources Ltd. (?) 442 Mt averaging 0.23% Cu and 0.40 g/t Au.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Gibraltar North deposit	1991	Discovered by Gibraltar Mines Limited. 33.5 Mt averaging 0.45% Cu and 3 g/t Ag.
Blackwater-Davidson deposit	1991	Inferred resource: 6 Mt grading 37.00 g/t Ag and 0.05 g/t Au.
Pine Porphyry Cu-Au deposit	1992	Stealth Minerals Limited and Electrum Resource Corporation. Discovered by Romulus Resources Ltd. 70 Mt grading 0.15% Cu and 0.57 g/t Au.
JD-Finn prospect	1992	AGC Americas Gold Corp. Possible reserves: 147 889 t grading 4.40 g/t Au.
Lloyd 2 deposit	1994	Big Valley Resources Inc. Inferred resource: 7 190 000 t grading 0.31% Cu and 0.243 g/t Au.
Akaie deposit	1994	Discovered by Metall Mining Corporation. 12 Mt grading 8.6% Zn, 1.5% Pb and 17.1 g/t Ag.
Crow-Rhea deposit	1994	Indicated resource: 500 000 t averaging 0.19% Mo.
Iskut wollastonite deposits	1994	Whitegold Natural Resource Corp.
Bril deposit		Measured resource: 1 020 000 t averaging 58.14% wollastonite.
Cliff deposit		Inferred resource: 2 000 000 t averaging 80.0% wollastonite.
Former Cariboo Gold Quartz mine property	1995	Owned by International Wayside Gold Mines Ltd. Indicated resource: 6 010 000 t grading 2.23 g/t Au.
NAK deposit	1995	Discovered by Hera Resources Inc. (now Medallion Resources Ltd.). 45.4 Mt grading 0.70% Cu equivalent (Cu-Au-Mo).
Tsacha deposit	1995	Discovered by Teck Corporation. Indicated resource: 478 000 t grading 8.72 g/t Au and 82.3 g/t Ag (3 g/t Au cutoff).
Afton deposit extension	2000	Additional tonnage discovered by DRC Resources Corporation. Main zone - indicated: 34.3 Mt grading 1.55% Cu, 1.14 g/t Au, 0.125 g/t Pd and 3.42 g/t Ag; inferred: 4.4 Mt (assumed grades as above). Northeast zone - indicated: 1.1 Mt grading 1.02% Cu, 0.86 g/t Au, 0.10 g/t Pd and 5.4 g/t Ag. (This tonnage includes the 9.5 Mt previously known below the open pit, which
Fir carbonatite	2001	Discovered by Commerce Resources Corp. 3.1 Mt averaging 196 g/t Ta_2O_5 and 645 g/t Nb_2O_5 plus 3.23% P.
YUKON		
Eagle Zone deposit	1991	Discovered by Ivanhoe Goldfields Ltd. and Amax Gold Inc. Geological potential resource 64.5 Mt at a grade of 1.03 g/t Au.
Kudz Ze Kayah property - Main deposit	1994	Discovered by Cominco Ltd. Indicated resource: 11.3 Mt averaging 5.89% Zn, 1.52% Pb, 0.3% Cu, 133.0 g/t Ag and 1.34 g/t Au. Inferred resource: 1.5 Mt averaging 6.4% Zn, 3.1% Pb, 0.1% Cu, 90 g/t Ag and 2 g/t Au.
Wolverine deposit	1995	Discovered by Westmin Resources Limited and Atna Resources Ltd. 6 237 000 t grading 1.33% Cu, 1.55% Pb, 12.66% Zn, 370.9 g/t Ag and 1.76 g/t Au (this deposit has a high selenium content; it may therefore be difficult or impossible to market concentrates without first reducing their selenium content).
Wolf deposit	1997	Discovered by Atna Resources Ltd. and YGC Resources Ltd. 4.1 Mt grading 6.2% Zn, 1.8% Pb and 84 g/t Ag.
Second Discovery at Kudz Ze Kayah	1998	Discovered by Cominco Ltd. 1 Mt averaging 6% Zn and 3% Pb + Cu, with Ag and Au.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
East Slope zone	1998	Discovered by Atna Resources Ltd. Tonnage and grade unknown. Intersected by six drillholes over a 250 x 100 m area, open in all directions, but continuity of mineralization disrupted by post-mineral intrusive rocks. Located 1.2 km east of the Wolf deposit.
NORTHWEST TERRITORIES		
Ekati diamond mine		All deposits discovered by BHP Minerals Canada Ltd. Mineral resources at end of June 2001 are as follows.
Fox kimberlite	1992	Mineable from open pit. Measured: 8.0 Mt grading 0.3 ct/t. Indicated: 8.2 million t grading 0.4 ct/t.
Koala pipe	1992	Mineable from open pit. Measured: 5.2 Mt grading 1.0 ct/t. Indicated: 2.3 Mt grading 0.9 ct/t. Mineable underground. Measured: 3.2 Mt grading 0.8 ct/t. Indicated: 3.6 Mt grading 2.1 ct/t.
Jay pipe	1993	Indicated 17.0 Mt grading 2.1 ct/t.
Leslie pipe	1993	Tonnage not available; grade about 0.33 ct/t (US$89/ct).
Misery pipe	1993	Mineable from open pit. Measured: 5.2 Mt grading 4.3 ct/t. Indicated: 1.2 Mt grading 4.5 ct/t.
Panda pipe	1993	Reserves prior to production - mineable from open pit: Proven and probable: 12.6 Mt grading 1.09 ct/t (US$130/ct). Mineable underground: Proven and probable: 0.8 Mt grading 0.97 ct/t (US$130/ct); mineral resources at end of January 2001 - mineable from open pit: Measured: 4.0 Mt grading 1.0 ct/t. Indicated: 2.1 Mt grading 1.0 ct/t. Mineable underground: Measured: 1.4 Mt grading 0.5 ct/t. Indicated: 1.0 Mt grading 1.0 ct/t.
Pigeon pipe	1994	Mineable from open pit. Measured: 3.1 Mt grading 0.5 ct/t. Indicated: 1.1 Mt grading 0.5 ct/t.
Sable pipe	1995	Measured: 12.0 Mt grading 0.9 ct/t. Indicated: 4.0 Mt grading 0.9 ct/t.
Beartooth pipe	1996	Measured: 1.1 Mt grading 1.1 ct/t. Inferred: 0.2 Mt grading 1.0 ct/t.
Koala North pipe	1996	Mineable from open pit. Measured: 0.1 Mt grading 0.5 ct/t. Mineable underground: Inferred: 11.2 Mt grading 0.5 ct/t.
Lynx pipe	1999	Measured: 1.1 Mt grading 0.8 ct/t. Indicated: 0.3 Mt grading 0.8 ct/t.
Damoti Lake deposit	1993	Discovered by Athabaska Gold Resources Ltd. Resource of 2.08 Mt grading 0.297 oz/t Au (includes 451 000 t in the Horseshoe zone grading 0.415 oz/t Au).
Diavik diamond project (deposits going ahead to production)		Owned by Diavik Diamond Mines Inc. and Aber Diamond Corporation.
A-154 South pipe	1994	Value per ct about US$67. Measured: 8.2 Mt averaging 5.6 ct/t. Indicated: 3.2 Mt averaging 5.1 ct/t. Inferred: 0.6 Mt averaging 3.2 ct/t.
A-154 North pipe	1995	Value per ct about US$35. Indicated: 6.9 Mt averaging 2.6 ct/t. Inferred: 4.6 Mt averaging 2.1 ct/t.
A-418 pipe	1995	Value per ct about US$56/t. Measured: 4.9 Mt averaging 3.4 ct/t. Indicated: 3.6 Mt averaging 3.8 ct/t. Inferred: 0.6 Mt averaging 3.5 ct/t.
A-21 pipe	1995	Value per ct about US$38. Indicated: 4.4 Mt averaging 3.1 ct/t. Inferred: 0.6 Mt averaging 2.7 ct/t.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Nico deposit	1995	Discovered by Fortune Minerals Limited. Indicated mineral resources: 112 977 000 t grading 0.05% Co, 0.11 g/t Au and 0.01% Bi, using a cutoff grade of 0.01% Co. Inferred mineral resources: 5 623 000 t grading 0.03% Co, 0.11 g/t Au and 0.01% Bi. The above grades can be increased using higher Co cutoff grades.
Snap Lake diamond deposit	1996	Owned by De Beers Canada Mining Inc. Discovered by Winspear Resources Ltd. Indicated resource: 22.8 Mt grading 1.65 ct/t. Inferred resource: 20 Mt of unspecified grade.
Gahcho Kue Project (formerly the AK [Kennady Lake] property)		Owned by De Beers Canada Exploration Inc., Mountain Province Diamonds Inc. and Camphor Ventures Inc. Four diamondiferous kimberlites have been defined to date. Exploration continues.
5034 Pipe (1)	1995	12 Mt grading 1.71 ct/t, valued at US$63/ct, or US$104/t.
Hearne Pipe (1)	1997	6.9 Mt grading 1.71 ct/t, valued at US$65/ct, or US$111/t.
Tuzo Pipe (2)	1997	10.2 Mt grading 1.22 ct/t, valued at US$43/ct, or US$52/t.
Tesla Pipe	1997	4.6 Mt grading 0.35 ct/t, valued at US$96/ct, (3) or US$36/t. (3)
NUNAVUT		
George Lake (5 deposits) and Goose Lake deposit	1985 to 1992	Kinross Gold Corporation. Discovered by Back River Joint Venture (Homestake Mining Company, Kerr-McGee Corporation and MacLab Group). Indicated resource: 4 238 000 t averaging 9.76 g/t Au.
Meadowbank Gold Project		Owned by Cumberland Resources Ltd. Total combined resources in Third Portage deposit (1990), North Portage deposit (1990) Goose Island deposit (3) (1991) and Bay Zone deposit (1997). Measured: 1 191 000 t at 6.58 g/t Au. Indicated 6 584 000 t at 5.65 g/t Au. Inferred: 3 467 000 t at 5.60 g/t Au. (The third Portage deposit was discovered by Asamera Minerals Inc. and Comaplex Minerals Corp.; the North Portage and Goose Island deposits were discovered by Comaplex Minerals Group and Cumberland Resources Ltd.)
PDF zone	1999	Discovered by Cumberland Resources Ltd. Resources not yet calculated.
Vault deposit	2000	Discovered by Cumberland Resources Ltd. Inferred resource: 7 470 000 t at 3.90 g/t Au.
Connector zone	2001	Discovered by Cumberland Resource Ltd. Resources not yet calculated.
Hope Bay Gold Project		Owned by Miramar Mining Corporation. Resources include:
Boston deposit	1992	Discovered by BHP Minerals Canada Ltd. Measured: 232 000 t grading 16.3 g/t Au. Indicated: 1 155 000 t grading 15.24 g/t Au. Inferred: 2 574 000 t grading 10.89 g/t Au.
Doris deposit	1995	Discovered by BHP Minerals Canada Ltd. Indicated: 887 000 t grading 21.53 g/t Au. Inferred: 1 678 000 t grading 15.05 g/t Au.
Madrid deposit	1996	Discovered by BHP Minerals Canada Ltd. Indicated: 532 000 t grading 7.78 g/t Au. Inferred: 845 000 t grading 11.3 g/t Au.
Naartok deposit	2001	Discovered by Miramar Mining Corporation and Hope Bay Gold Corporation Inc. Indicated: 558 000 t grading 12.82 g/t Au. Inferred: 312 000 t grading 11.96 g/t Au.
Suluk deposit	2001	Discovered by Miramar Mining Corporation. Inferred: 1 302 000 t grading 12.14 g/t Au.
Inukshuk Zone deposit (at Izok Lake)	1992	Owned by Inmet Mining Corporation. 2 Mt grading 2% Cu and 8% Zn.

TABLE 4 (cont'd)

Province or Territory/ Project Name	Discovery Year	Remarks
Meliadine East Discovery zone	1992	Owned by Cumberland Resources Limited and Comaplex Minerals Corp. Discovered by Asamera Minerals Inc. and Cumberland Resources. Indicated: 1 841 000 t grading 6.7 g/t Au (cut).
Meliadine West Gold Project		Owned by WMC International Limited, Cumberland Resources Ltd. and Comaplex Minerals Corp. Resources all calculated using a 3 g/t Au cutoff. Exploration continues. Total Meliadine West resources: 22 148 000 t averaging 6.33 g/t Au.
F-zone deposit	1993	Discovered by Cumberland Resources Ltd. and Comaplex Minerals Corp. Inferred: 4.1 Mt averaging 5.0 g/t Au.
Pump zone deposit	1994	Discovered by Cumberland Resources Ltd. and Comaplex Minerals Corp. Inferred: 1.4 Mt averaging 6.9 g/t Au.
Tiriganiaq deposit	1995	Discovered by WMC International Limited. Indicated: 5 212 000 t averaging 7.7 g/t Au. Inferred: 7 136 000 t averaging 6.1 g/t Au.
Wolf Main deposit	1995	Discovered by WMC International Limited. Inferred: 2.5 Mt averaging 6.0 g/t Au.
Wolf North deposit	1998?	Discovered by WMC International Limited. Inferred: 1.1 Mt averaging 5.7 g/t Au.
Tiriganiaq West deposit	2000?	Discovered by WMC International Limited. Inferred: 700 000 t averaging 6.7 g/t Au.
Jericho Diamond Project	1995	Owned by Tahera Corporation. Mineable resource in the JD/OD-1 pipe is 2.5 Mt with a diamond content of 1.19 ct/t (US$75/ct). Total resource: 7.1 Mt averaging 0.84 ct/t.
Fergusson Lake deposit	1999	Owned by Starfield Resources Inc. Original discovery by Inco Limited in 1952. Current resources: 60 Mt averaging 0.59% Ni, 0.93% Cu, 1.32 g/t Pd and 0.19 g/t Pt. Known resources prior to 1999 were 7.3 Mt averaging 0.80 Ni and 0.70% Cu.

Source: Natural Resources Canada.

. . Not available.

(1) Modelled grades and revenues. (2) Revised data from 1999 bulk sampling program. (3) Values based on 1998 mini-bulk sample; tonnage and grade based on 1999 bulk sample.

Canadian Mine Openings, Closings, Expansions, Extensions and New Mine Developments

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OVERVIEW

In the face of continued weak gold and base-metal prices, 2001 turned out to be one of the most depressed years for mining in Canada in recent decades. During the year, at least fifteen mines closed and only two small new mines were brought into production (Tables 1 and 2), continuing a recent trend in which gold and base-metal mine closures have outpaced mine openings since 1997. Of the two new mines that came on stream, one was a gold mine and the other was an industrial mineral mine. Of the fifteen mine closings, seven were permanent closures (three gold, one base-metal, and three industrial minerals) and eight were production suspensions (six gold, one base-metal and one uranium). Three of the mines that closed (one gold, one base-metal and one industrial mineral) were owned and operated by foreign companies.

The new mines that opened in 2001 were the Hammerdown gold mine in Newfoundland and Labrador and the Ashcroft basalt granules mine in British Columbia. With a planned annual output of 250 000 t of basal roofing granules, the Ashcroft mine is a significant industrial mineral operation in southern British Columbia. However, in terms of value of expected production and employment, these two mines are small operations and would be considered significant only from a regional perspective in 2001.

The year 2001 marked the closure of two significant mines in Canada. In Nova Scotia, the Prince coal mine closed in November due to high costs and a lack of private sector interest. The Prince mine, which came on stream in August 1975, was the last mine in Canada that was owned and operated by the federal government. In British Columbia, the Sullivan zinc-lead-silver mine, a world-class mine, closed in August due to depletion of ore reserves. The Sullivan mine was first developed for production in 1909. Other mine closures across Canada in 2001 are described below.

In Newfoundland and Labrador, the Nugget Pond gold mine closed in December due to depletion of underground ore reserves. The Coal Creek open-pit coal mine in New Brunswick closed in August due to depletion of pit reserves. In Quebec, the Francoeur gold mine closed in November due to ore exhaustion and the Luzenac talc-soapstone mine closed in April after the discovery of asbestos fibre in talc concentrates. In British Columbia, the Golden Bear gold mine, the first heap leach gold mine in the province, completed its final year of production in late 2001.

In addition to production suspensions and mine closures, production cutbacks continued at several mines in 2001, especially at gold, base-metal, coal, uranium and iron mines, which created additional employment losses during the year. However, job losses through production cutbacks amounted to less than 200 in 2001. Although this was an improvement when compared with the 250 job losses in this category in 2000, it extended a trend that started in 1997 and that has negatively affected regional economies.

In an effort to cut costs, mining companies continued to consolidate mine operations or maintain recently struck operation-sharing accords since 2000, notably at McWatters Mining Corporation's Sigma gold mine (a pre-expansion consolidation at the Sigma-Lamaque mining complex) in Quebec; at Barrick Gold Corporation and Teck Cominco Limited's David Bell gold mine and Williams mill, and at Newmont Canada Limited's Holloway mine and Barrick Gold Corporation's Holt-McDermott mill, all in Ontario; and at Miramar Mining Corporation's Con and Giant gold mines in the Northwest Territories. While cost-cutting measures continued at all mines, significant results were achieved at several gold and base-metal mines, such as the Bouchard-Hébert zinc-copper-gold-silver mine and LaRonde gold mine in Quebec; the Creighton, McCreedy East and Garson nickel-copper mines and the Red Lake and Williams gold mines in Ontario; the Birchtree nickel-copper mine and the New Britannia gold mine in Manitoba; and the Kemess South gold mine in British Columbia.

Despite widespread mine closings and production cutbacks at some mines, there were at least 10 significant mine expansion and extension projects across Canada (Table 2). However, there were no significant new project announcements in 2001 and all 10 projects were the continuation of existing programs that began in recent years. These were the Carol Lake iron ore operation in Labrador; the LaRonde gold-zinc-copper-silver mine and the Niobec niobium mine in Quebec; the Red Lake gold mine, the Kidd Creek zinc-copper-silver mine, the Creighton, McCreedy East and Stobie nickel-copper mines, and the Lac des Iles palladium-platinum-gold-copper-nickel mine in Ontario; and the Birchtree nickel-copper mine in Manitoba.

The total capital cost for bringing the two new mines into production in 2001 was estimated at about $40 million, the lowest in more than a decade. However, over $360 million was estimated to have been spent by companies on mine expansions and mine-life extensions, one of the highest investment levels in over a decade. Given the generally depressed mineral commodity prices and market conditions, this indicates that relatively high levels of capital investment, compared with exploration spending, have been maintained in Canada in recent years, reflecting the need for current producers to maintain or expand production capability through mine-site and new project developments, even during hard times. As more mines are expected to open or re-open in 2002, capital investment next year is expected to be higher.

REGIONAL PERSPECTIVE

During 2001, eight provinces and one territory were affected by mine openings or closings. In terms of employment, ore capacity and production losses, British Columbia suffered the most, followed by Nova Scotia, Quebec and Manitoba. In terms of the overall impact on mining, except for placer gold operations, the Yukon now has no producing mines and the Government of Canada no longer involves itself in the direct operation of a mine nor has it any mine ownership interest in Canada.

Newfoundland and Labrador

The small 375-t/d, high-grade Hammerdown gold mine near Baie Verte, Newfoundland and Labrador, was brought into production in early July 2001 at an estimated capital cost of about $10 million. The mine was developed by Richmont Mines Inc. in time to replace the company's nearby Nugget Pond gold mine, which subsequently closed in December due to ore depletion. The Nugget Pond mine began commercial production in April 1997 and was a high-grade and low-cost mine. Gold production from Hammerdown was expected to be 25 000 oz in 2001. Planned annual production is estimated at 50 000 oz. At the start of production, mine reserves stood at 443 000 t grading 16.11 g/t (0.47 oz/st) gold, or 210 000 oz. The mine hosts an additional resource of 334 000 t grading 11.31 g/t (0.33 oz/st) gold, or 110 000 oz. The remaining mine life is estimated at six years. Although 50 mining jobs were created when the Hammerdown mine opened, the jobs essentially replaced most of the remaining ones at the Nugget Pond mine when it closed, resulting in the net loss of 10 mining jobs due to mine openings and closings in Newfoundland and Labrador at the end of 2001.

Nova Scotia

On November 16, 2001, the Prince coal mine near Sydney closed as the mine owner failed to secure a buyer for the mine, resulting in the loss of 440 mining jobs. The 3850-t/d Prince mine was the largest remaining coal mine in Nova Scotia. The mine began production in August 1975. It was one of two coal mines in Nova Scotia that were owned by the Government of Canada and operated by the Cape Breton Development Corporation (DEVCO), a Crown corporation. The other coal mine was the Phalen mine, which closed in December 1999. Both the Prince and Phalen (the larger of the two) mines were high-cost underground coal mines in which substantial coal resources still remain. Overall, in 2001, Nova Scotia incurred net losses of 440 mining jobs and 3850 t/d of mine production capacity due to the mine closure.

With the closure of the Prince mine, the Government of Canada no longer has a direct ownership interest in any mine nor involves itself in the operation of a mine in Canada. Therefore, the year 2001 not only put an end to the continued federal subsidy to mining in the region, but it also marked an end to any direct federal government competition with the mining industry in Canada.

New Brunswick

The small 470-t/d Coal Creek coal mine near Minto closed in August due to exhaustion of its thermal coal reserves, resulting in the loss of 20 mine workers. The mine was one of five original coal mines in the area that were developed by N.B. Coal Limited to supply the nearby NB Power's power station. With the closure of Coal Creek, the only coal mine that remains open in the area is the Salmon Harbour mine, which is the last producing coal mine in the province. Salmon Harbour, originally scheduled to close in 2004, may close in 2003 to coincide with the early closure of the power plant. Due to poor market conditions, production was suspended at Potash Corporation of Saskatchewan Inc.'s Penobsquis potash mine near Sussex in November for six weeks to reduce excess inventory. Mining in other regions of New Brunswick, however, was not affected by mine openings or closures in 2001. In fact, the Brunswick zinc-lead-copper mine, the province's sole metals producer, was able to increase production by increasing throughput to offset weak metal prices.

Quebec

Three mines closed and there were no mine openings in Quebec in 2001. The 1225-t/d Francoeur gold mine near Rouyn-Noranda closed in November due to depletion of economic ore reserves and failure to prove up the newly discovered Zone 7 at depth. The small Luzenac talc-soapstone mine near Saint-Pierre-de-Broughton closed in April due to the discovery of asbestos in the talc concentrates, making the concentrates unmarketable. In mid-February, production was suspended at the Sigma-Lamaque gold mine near Val-d'Or due to high costs. Subsequently, owner McWatters Mining Inc. successfully obtained approval from the Superior Court of Quebec of a plan to restructure its shares, debts and other liabilities to stabilize the company's financial position. A debt reduction and mine redevelopment and financing plan was put in place involving SOQUEM INC., Investissement Québec and Canada Economic Development. The plan will include the expansion of the Sigma-Lamaque mill from its current 3000-t/d capacity to 5000 t/d. Production from the open-pit operation is scheduled to begin in the fourth quarter of 2002 and to reach full production in the second quarter of 2003. Gold production is expected to be 150 000 oz annually over a seven-year mine life at an average total operating cost of US$212/oz.

As the result of a significant cut in contracts by its clients due to continued depressed business, Wabush Mines announced in September 2001 that it was temporarily shutting down its iron ore mining and pellet production in October and later extended the shut-down to November 19, reducing its production plan for 2001 by 6% to 4.5 Mt. Similarly, Quebec Cartier Mining Company's Mount Wright mine and pellet plant were shut down for a month in December.

Overall, in 2001, Quebec suffered net losses of some 4400 t of daily ore capacity and about 180 direct mining jobs from mine openings and closings. As two of the three mines that closed in 2001 were gold mines, the province continued to suffer from the recent decline of its gold and base-metal mining industry, which started in 1999 when one base-metal and four gold mines closed.

Ontario

In Ontario, production was suspended at two gold mines and there were no new mines or re-openings in 2001. The 1000-t/d Glimmer mine near Matheson closed in May due to weak gold prices and the 250-t/d Edwards mine shut down in July due to high costs, resulting in the loss of 140 mining jobs. At the Edwards mine, only small amounts of ore reserves are remaining and recent efforts to find more ore on site have not been successful. Nevertheless, owner River Gold Mines Inc. intends to continue further deep exploration on the property when gold prices are significantly more attractive. Improvements in gold prices since March 2002 have been encouraging to the company. At the Glimmer mine, partners Exall Resources Limited and Glimmer Resources Inc., since resolving a long-standing dispute relating to their respective ownership interest in the mine in 2000, were negotiating financing with a view to re-opening the mine for production. Exall is now the mine's majority owner and operator. Overall, in 2001, Ontario incurred net losses of 1250 t/d of ore production capacity and 140 direct mining jobs as a result of mine openings and closings.

Manitoba

During 2001, one mine closed and there were no new mine openings or re-openings in Manitoba. In August, production was suspended at the 1000-t/d Bissett gold mine, located 170 km northeast of Winnipeg, causing the loss of 230 mining jobs. The Chisel North zinc-copper mine near Flin Flon formally began production in July 2000. However, the official opening of the mine by the company was held a year later on June 1, 2001. The mine is part of the $400 million "777 Project" at Flin Flon being developed by Hudson Bay Mining and Smelting Co., Limited. A second mine under the project is the larger 777 mine, which is scheduled to begin production in late 2003 with commercial production expected in 2004. In addition to the two mines, the 777 project will result in an upgraded and more environmentally friendly copper smelter, an expansion of the Flin Flon concentrator, a new-technology electrolytic zinc cell-house, and many productivity improvements.

Saskatchewan

Production was suspended at the Rabbit Lake uranium operation in June 2001 after the milling of stockpiled ore was completed. The mine employed a work force of 150. About 50 workers were kept on site for care and maintenance. Initially, underground mining activity at Rabbit Lake was suspended in 1999 and the suspension was extended to 2001 in the wake of continued weak uranium prices. As a result of the shut-down, the province incurred net losses of some 1000-t/d of uranium ore production capacity and 100 mine jobs. However, as a result of improvements in uranium prices since the fourth quarter of 2001, along with a forecast for a further increase in demand for uranium in the foreseeable future, owner Cameco Corporation announced a decision to re-open the Eagle Point mine for production in the summer of 2002. At the McArthur River uranium mine, located some 280 km north of La Ronge, underground drilling successes in the No. 3 and No. 4 zones and reinterpretation of existing drill data for the No. 1

and No. 2 zones, for which ore grades were underestimated, resulted in the outlining of additional ore reserves in 2001. In late January 2001, mine reserves were re-established at 845 000 t grading 21.18% U_3O_8, compared with 668 000 t grading 17.33% of U_3O_8 at the end of 1999 when the mine began production. This resulted in a 50% increase in uranium reserves and an additional eight years to the 10+ years of originally expected mine life at the mine. The McArther River mine is the world's largest and highest-grade uranium mine.

British Columbia

With the opening of one new industrial mineral mine but the closing of four major metal mines in 2001, British Columbia suffered a third consecutive year of being hit hard by mine closings. The new mine that opened was the 750-t/d Ashcroft basalt roofing granules mine near Ashcroft. The open-pit mine, developed by I.K.O. Industries Ltd. at a capital cost of some $25 million-$30 million, was brought on stream in July, creating 60 mining jobs. Its annual production is estimated at 250 000 t. Production was suspended at the 18 000-t/d Mount Polley open-pit gold-copper mine near Williams Lake in September due to weak metal prices. About 240 of the 250 workers were laid off. Prior to the shut-down, a new mineralized zone was discovered on the property. Owner Imperial Metals Corporation has since been conducting studies to extend mine reserves and resources and to lower costs in an effort to reactivate the mining operation. At the Golden Bear gold mine, located some 150 km west of Dease Lake, production was completed in late 2001. The mine, which first began production in November 1989, had been a conventional open-pit and underground operation until 1997 when it became the first heap leach gold mine in the province. In early December, production was halted at the 4000-t/d Myra Falls underground zinc-copper-gold mine near Campbell River on Vancouver Island, also due to weak metal prices. In March 2002, an agreement was reached between owner Boliden Limited and employees, unions, suppliers and customers to cut costs and streamline operations and the mine was re-opened. However, as part of the agreement, the work force was reduced by 17% and wages, salaries and contracts with suppliers and contractors were adjusted. The largest impact on British Columbia's mining industry in 2001 was the closure of the 9000-t/d Sullivan zinc-lead-silver mine near Kimberley. After 92 years of active production, the world-class Sullivan mine closed on December 21. More than 410 of the remaining 444 workers were laid off. About 31 workers were kept on site for maintenance and environmental work. The impact of mine closings in British Columbia in 2001 also dealt the mining industry a significant blow as the closure of the Sullivan mine and production suspensions at the Myra Falls mine temporarily eliminated the province as a zinc producer in Canada between December 2001 and March 2002. Overall, in 2001, however, the province incurred significant net losses of some 31 000 t/d of ore capacity and over 1100 mining jobs.

Yukon

Although mining at the Brewery Creek gold mine was suspended in late 2000 due to weak gold prices, gold production continued in 2001 from the heap leaching operation. About 70 jobs were lost when the mine shut down in December 2001. At year-end 2001, the mine was without mineable reserves and only about 92 000 t grading 1.45 g/t gold of measured and indicated resources were remaining. Over the final months of 2001, owner Viceroy Resources Corporation completed a Heads of Agreement with the Government of Canada providing for the establishment of a reclamation trust. The trust will be funded by more than $8 million in cash deposits already set aside by Viceroy to finance future reclamation work at the Brewery Creek mine. Under the agreement, Viceroy will be able to draw funds from the trust to accomplish the decommissioning and reclamation work as required under the closure plan. Since the closing of the Brewery Creek mine, the Yukon is without any producing hard-rock mines.

MINE EXPANSIONS AND EXTENSIONS

Despite continued low prices for many mineral commodities in 2001, at least ten significant mine expansion and extension projects, mostly precious and base-metal mines, were newly started, continued or further expanded in the year (Table 2): one in Newfoundland and Labrador, two in Quebec, six in Ontario, and one in Manitoba. Two of these projects were new starts and the rest were continuations of existing programs, including six world-class mines. One expansion project and one mine-life extension project were concluded in 2001.

Newfoundland and Labrador

Although Iron Ore Company of Canada's $1.1 billion, six-year expansion and modernization program for its mine, concentrator and pellet plants in Labrador and Quebec (which started in October 1998) continued in 2001, it was put into low gear as iron ore demand and prices were weak. As a result, completion of a $361.5 million program to reactivate a pellet plant that was mothballed in 1982, at Sept-Îles, Quebec, has been postponed. The plant was originally scheduled to re-open in 2002 with the creation of 140 long-term jobs.

Quebec

The US$218 million expansion program that started in 1997 at the LaRonde gold mine in Quebec entered

Phase 2 in 2001. Phase 1 of the expansion program, which included the completion of sinking of the Penna Shaft to a depth of 7065 m and the expansion of mill capacity to 4550 t/d from 3265 t/d in 2000, resulted in record gold production of 234 860 oz of gold in 2001, an increase of 35% over 2000. The cash cost in 2001 averaged US$155/oz, an 18% decrease from the previous year. In 2001, capital expenditures amounted to some $36 million, substantially lower than 2000 ($68 million) and 1999 ($69 million), as most of the physical infrastructure for the expansion to 4550 t/d was completed prior to 2001. After a year of production, mine reserves were higher than a year before due to continued successes in mine-site exploration and development. As of December 31, 2001, mineable reserves stood at 33.03 Mt grading 3.08 g/t gold, 4.05% zinc, 0.36% copper and 78.86 g/t silver. Mineral resources stood at 30.6 Mt grading 5.48 g/t gold, 0.52% copper, 0.44% zinc and 22.97 g/t silver. The gold content of reserves and resources amounted to 8.5 million oz, compared with 7.8 million oz in 2000 (an increase of 28% over 1999), making the LaRonde deposit the largest gold deposit in Canada and one of the largest in the world. Phase 2 of the expansion program will see a further expansion of mill capacity to 6370 t/d by the end of 2002. Gold production in 2002 is expected to increase to 340 000 oz at a cash cost of US$130/oz, and to reach 400 000 oz by 2004 at a cash cost of US$100/oz or lower when the lower gold-copper-rich portion of the orebody is fully developed. Recent exploration has identified a potential new ore zone east of LaRonde on the El Coco property.

At the Niobec niobium mine near Chicoutimi, a $15.7 million, two-phase capital program that began in 1998 to develop deep ore and expand production capacity was substantially completed in early 2001. During 2001, capital expenditures were $2 million, compared with $6.2 million in 2000 and $3.8 million in 1999. Also during 2001, mill capacity, which was expanded at a cost of $4 million, was increased to 2700 t/d from 2400 t/d. Production in 2001 was 3006 t of niobium, a 20% increase over 2000. As of December 31, 2001, mine reserves stood at 18.2 Mt grading 0.68% Nb_2O_5, a 60% increase over 2000 (11.4 Mt grading 0.73% Nb_2O_5), extending the mine life by another six years to at least 2016. In March 2001, Tech Corporation sold its 50% interest in the Niobec mine to Mazarin Inc. for $48 million. Mazarin also became the operator of the mine with partner Cambior Inc. responsible for the worldwide marketing of the ferroniobium. In 2002, the partners plan to maintain the levels of niobium production and capital investment of 2001, but will evaluate plans to gradually increase production by another 20% in order to maintain their market share as world use of ferroniobium is expected to increase. Niobec is the only producer of niobium in North America and is one of three important producers in the world.

Ontario

Continued successes in mine-site exploration and development since the re-opening of the Red Lake gold mine at Balmertown in 2000 led to a series of upward adjustments to the mine's ambitious production expansion and mine-life extension program in 2001. The Red Lake mine produced 85 115 oz of gold in 2000, its first year of production resumption. In 2001, gold production, mainly from the High Grade Zone (HGZ), was a record 503 385 oz at a cash cost of US$59/oz, significantly exceeded the original feasibility study's forecasted annual production of 240 000 oz at a cash cost of US$88/oz, making the Red Lake mine Canada's largest gold-producing mine and one of the two lowest-cost gold mines (the other being the Eskay Creek mine in British Columbia). For 2002, gold production was forecast at 475 000 oz at a cash cost of less than US$70/oz. As of December 31, 2001, ore reserves in the HGZ were 1.7 Mt grading 69.3 g/t (2.02 oz/st) gold, for a total of 3.78 million oz, an increase in gold content of 25% over 2000. The high-grade resources have increased to 430 000 t grading 92.6 g/t (2.70 oz/st) gold, for a total of 1.28 million oz. In 2002, an exploration program at the mine will focus on the depth and east and west extensions of the HGZ, the extensions of the lower-grade sulphide mineralization at depth, and the newly discovered Far East Zone.

A $220 million expansion program that started in 2000 at the Lac des Iles palladium mine near Thunder Bay continued in 2001. A new concentrator, which was completed in June 2001, boosted the mine's ore throughput capacity to 15 000 t/d from 2400 t/d. However, a number of milling and concentrator circuit-related problems reduced throughput performance and recovery to below the designed rates in 2001. Most of the problems have since been corrected and annual palladium production from the mine is expected to increase in 2002 to 250 000 oz, or about 5% of the world's annual supply of palladium. Since December 2001, the mine has undergone a cost-reduction and streamlining exercise to reduce mining operation and ancillary services with a work force reduction. During 2001, the faulted extension of the Main High Grade Zone at depth was discovered and was referred to as the "Offset High Grade" Zone. The intercepts within this zone were exceptional with an average palladium grade of 5.2 g/t over a true thickness of 23 m. As of December 31, 2001, ore reserves at the mine were 93.5 Mt grading 1.53 g/t palladium (4.6 million oz), 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel. Measured and indicated resources stood at 65.9 Mt grading 1.58 g/t palladium (3.3 million oz), 0.17 g/t platinum, 0.11 g/t gold, 0.05% copper and 0.05% nickel. A further 73 Mt were classified as inferred, grading 1.57 g/t palladium, 0.15 g/t platinum, 0.10 g/t gold, 0.05% copper and 0.05% nickel. The mine life, based on current reserves and rate of production, will be at least

17 years from 2002. At full production starting in 2002, annual mine output is expected to be 250 000 oz of palladium, 23 000 oz of platinum, 18 000 oz of gold, 6 million lb of copper and 2 million lb of nickel. The average cash cost over the mine life, net of by-product credits and royalty, is estimated at US$200/oz of palladium. The mine currently employs a work force of 275, compared with 130 prior to the expansion. The Lac des Iles mine is Canada's only primary palladium mine.

At the Kidd Creek copper-zinc-silver mine in Timmins, the development of Mine D – a $640 million deep development program to extend the mine life at Kidd Creek – was accelerated in 2001. During 2001, development was focussed on the section between 2100 m (6800 ft) and 3100 m (10 000 ft), giving access to an additional 10.3 Mt of reserves and 14.1 Mt of resources in two stages. While Stage 1 of the development will take the mine to the 2700-m level, Stage 2 will extend the mine down to 3100 m, making Kidd Creek the deepest base-metal mine in the world. Stage 1 involves the development of 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver, whereas ore for the Stage 2 development is estimated at 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. As of December 31, 2001, ore reserves at the Kidd Creek mine, including Mine D, totalled 24.98 Mt grading 2.2% copper, 6.32% zinc and 68 g/t silver. The mine also hosted a small indicated resource of 348 000 t grading 2.06% copper, 6.69% zinc and 30 g/t silver, and an inferred resource of 14.15 Mt grading 3.35% copper, 4.90% zinc and 91 g/t silver, which came essentially from Mine D. Work has begun to sink a new underground shaft from about 1460 m to 3100 m. This shaft will replace the No. 3 shaft once Mine D is brought on stream. Production from Mine D is scheduled to begin in 2004 at a rate of 2 Mt of ore annually. The current mine-life extension project at Kidd Creek is by far the largest deep ore development and mine extension project in Canada.

In the Sudbury Basin, Inco Limited's three production expansion and mine-life extension programs for its nickel-copper operations continued in 2001. At the Creighton mine, the first phase of the US$125 million Creighton Deep Project, which involves the development of proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper between the 7400-ft and 7660-ft levels, was substantially completed in 2001. Production from this ore, which began in 2001, is expected to last through to 2013. Capital expenditures in 2001 were estimated to be some $20 million. In the second phase, development will extend down to the 8180-ft level to develop and mine some 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper between 2005 and 2019. Creighton Deep is scheduled to be operational in 2002; annual production from the mine is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals. As the current average grades of Inco's Ontario Division mines are 1.3% nickel and 1.2% copper, the deep development project at Creighton is undoubtedly one of the company's most significant mine extension and expansion projects in Ontario in recent years. The Creighton mine, discovered in 1856 and brought on stream in 1901, celebrated a century of continuous production in 2001. It is Inco's oldest operating mine. At the McCreedy East mine, a new $46 million (US$33 million) capital program, which was initiated in June 2000 to develop the newly discovered high-grade nickel deposit nearby, forged ahead in 2001. It will involve mine development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004, with metal production of 21 772 t of nickel and 41 700 t of copper. The mine has other mineral zones and has the potential to extend its current life of 15 years. The McCreedy East mine, which underwent a $194 million expansion between 1997 and 1999, is one of Inco's four key mines in Ontario and one of the company's lowest-cost mines in the province. The other three are the Creighton, Copper Cliff North and Copper Cliff South mines. At the Stobie mine, the development of a low-grade component of the Stobie mine that started in 2000 was completed in 2001. This development and other related mine-life extension work in the main part of the mine is expected to enable it to produce over 20 000 t of contained nickel annually over the next 15 years starting in 2001.

Manitoba

A US$48 million ($70.4 million) plan to deepen the Birchtree nickel mine near Thompson to expand production and to extend the mine life by at least 15 years began in 2001 and was progressing as planned. The two-year capital program will deepen the mine and increase the daily production capacity to 3175 t from 1635 t while reducing costs by 25%. Capital investment in 2001 is estimated at $35 million. A redesigned mine development plan by a joint Inco and union team could see further lowering of costs and accelerated cash flow. As well, deepening the mine will increase ore reserves to 13.6 Mt grading 1.79% nickel. After deepening, the mine is expected to reach full production in 2004. Inco is also studying the deepening of its Thompson 1-D orebody and is re-surveying the entire Thompson Nickel Belt. These activities are all part of Inco's strategy to focus on discovering new mineralization at and near existing mines and previously known deposits.

In addition to the above major projects, several mines across Canada have also undergone relatively significant expansion or mine-life extensions in 2001. In an effort to lower production costs, expansion continued at the Sigma-Lamaque mining complex near Val-d'Or, Quebec. In Manitoba, as part of the $400 million 777 Project to develop two new mines (the Chisel North mine near Snow Lake already began production in 1999; the 777 mine in Flin Flon is still under development), expansion of the Flin Flon concentrator continued in 2001. The new 777 shaft is scheduled for completion by the end of 2002. In Alberta, a decision to mine an additional 1.2 Mt of metallurgical coal has extended the mine life at the Luscar coal mine by six months to the end of 2002 as a result of improved market conditions for coal. There was also renewed interest in developing the Cheviot coal project near Hinton, possibly as early as 2003. At the Polaris zinc-lead-silver mine in Nunavut, better-than-projected pillar recovery, combined with the addition of 350 000 t of ore from a 6000-m drilling program, is expected to extend the mine life to August 2002. The mine was previously scheduled to close at the end of 2001.

In addition to new mine developments, the major mine expansion and extension programs described above continue to indicate that, due to difficult times in recent years brought about by lingering weak metal prices and financing difficulties, mining companies in Canada have been concentrating their financial resources on mine-site exploration and development instead of off-site exploration and developing new mines. The results also show that mining companies were able to continue to discover new ore at existing mines. The successes of such discoveries and follow-up developments have enabled the mines to extend their lives and expand production, which in turn has enabled the mines to reduce production costs and stay competitive and economically viable. Although most expansion or extension projects seldom resulted in large increases in new mining jobs, over 300 new jobs were created from such projects in 2000 and 2001, most significantly at the LaRonde and Lac des Iles mines; these were sufficient to mitigate job losses due to production cutbacks at many gold, uranium and coal mines in 2000 and, to a lesser extent, in 2001 as most new jobs were created in 2000.

IMPACT

In 2001, the two small new mines brought on stream some 1125 t of daily ore production capacity and created some 100 mining jobs, the smallest amount of daily ore capacity and lowest number of new jobs in more than a decade. However, about 56 300 t/d of ore capacity and 2400 jobs were lost from mine closures and production suspensions, resulting in a net loss of 13 mines, significant net losses of nearly 55 200 t of daily ore capacity and more than 2300 direct mining jobs. The largest contributors to the job losses were the Prince, Bissett, Mount Polley, Myra Falls and Sullivan mines. Layoffs at these mines constituted 78% of the net loss from mine closures in 2001. The same five mines also contributed to 65% of the net capacity loss in the year.

In addition, production cutbacks again resulted in many job losses during the year, especially at gold, base-metal, uranium and coal mines. Total job losses due to production cutbacks during the year were estimated at about 200. Although this was an improvement over 2000 and a significant improvement over 1999 in which more than 250 and 900 jobs, respectively, were lost from production cutbacks, it nevertheless continued the trend of job losses in addition to those from mine closings. This also makes 2001 the fifth consecutive year of job losses due to cutbacks at producing mines across Canada.

Mine openings ensure immediate access to new or redeveloped sources of economic mineral supply, new production capacity and capability, and new mining jobs. They also reflect Canada's mine-building ability and its attractiveness to mining investment in the face of global competition and globalization. In 2001, mine openings continued to be outnumbered by mine closings and a recent trend in which base-metal mines are lacking in both number and size also appears to have persisted. Gold and basalt granules mine openings during the year represent dismal additions to Canada's total minerals and metals production capability. Overall, at full capacity, production from new mines in 2001 is expected to add a meager 1.7 t (50 000 oz) of gold and 250 000 t of basalt roofing granules annually (Table 3) to Canada's total minerals and metals production. While all of the new gold production will come from the Hammerdown mine in Newfoundland and Labrador, all of the new basalt roofing granules production will come from the Ashcroft mine in British Columbia. Gold production from the Hammerdown mine is expected to be adequate to offset production losses from the closure in 2001 of the Nugget Pond mine located some 140 km northeast of Hammerdown.

Table 4 shows that new mines in 2001 have also added over 6.9 t, or 201 300 oz, of gold reserves and 18 Mt of basalt roofing granule reserves to Canada's total reserves of this metal and mineral. Except for basalt roofing granules, gold reserves from the new mine would be insufficient to replenish depleted reserves due to production and to sustain Canada's gold production capability.

NEW DEVELOPMENTS EXPECTED TO BECOME MINES IN 2002

Preliminary estimates, based on mine development activities in 2001 and the first half of 2002, indicate that eight mines, two of which will be new mines, could come on stream in 2002. Among the most promising new mines are Melford (gypsum) in Nova

Scotia and Mishi (gold) in Ontario. In addition, the Beaufor and Joe Mann gold mines in Quebec, the Macassa gold mine in Ontario, the Myra Falls zinc-copper-gold-silver mine in British Columbia, and the long-awaited CanTung tungsten mine in the Northwest Territories all have re-opened in the first half of 2002, and the Eagle Point uranium mine in Saskatchewan is scheduled to resume production in August. As well, two diamond projects, namely Misery and Koala North, now part of the Ekati mining complex at Lac de Gras, Northwest Territories, are scheduled to come on stream in 2002. Production began at the Misery kimberlite pipe in January and test underground mining also started at the Koala North pipe.

In addition, several previous mine expansion and extension projects, as well as new ones that were initiated in 2001, are expected to continue in 2002 with others likely to be announced during the year. These mine expansions and mine-life extensions, together with new mine developments, are central to sustaining mining and production in Canada. In the face of weak prices for many minerals and metals and without having to resort to significant layoffs, mine expansion remains an effective option by which production costs can be lowered and productivity increased at an existing mine. Such an option is especially beneficial for mines that have significant new mine-site ore discoveries, for example, the LaRonde and Niobec mines in Quebec; the Lac des Iles, Red Lake, Kidd Creek, Creighton, McCreedy East and Stobie mines in Ontario; and the Birchtree mine in Manitoba, all of which have been discussed above, as well as the Ekati diamond mine and many others that are still in the planning stage.

OUTLOOK

The overall weak global demand for metals and depressed gold and base-metal prices since 1997 lingered on throughout most of 2001 and continued to put a lid on exploration and new mine development across Canada. Exploration spending and capital investment on new mine development, as well as base-metal mine reserves (particularly copper and zinc), reached alarming levels in 2001, bringing Canada's mine production capability for these metals to its lowest level since 1981. Not surprisingly, the number of mine openings in Canada in 2001 declined to its lowest level in more than a decade while mine closings continued to outnumber mine openings. Canada's traditionally strong gold and base-metal mining camps were particularly affected. As well, while previously marginal mines have fallen prey under the circumstances, some mines that were previously profitable have now become marginal.

Canadian companies continued to respond to these adverse market conditions by closing down high-cost mines, consolidating operations by integrating mining operations, cutting back on production and work force, negotiating salary and wage concessions from workers, imposing or extending vacation shut-downs, revamping mining methods, expanding production capacity, or postponing mine openings and developments. However, many mines appear to have reached their limits for further technical or economic improvements and the costs of further improvement would outweigh the anticipated benefits. In these cases, mine shut-down becomes an inevitable option. This situation has also resulted in accelerated production and premature mine closures such as in the cases of the Sullivan mine in 2001, Nanisivik in 2002, and Ruttan in 2003. Most mines are expected to continue to focus their efforts on extending mine life and improving operating costs.

Currently, the most damaging factor for mine development and mine openings in Canada is the economic uncertainty in the United States, Japan and western Europe. Since the current economic slowdown in the United States set in during the second half of 2000, there has been no convincing sign of sustained economic recovery. This has affected trade and demand for minerals in North America and western Europe. As well, the long-awaited economic recovery in Japan since the metal downturn that started in 1997 has never materialized. Although demand for metals in China remains strong, it is not yet sufficient to displace the overall negative impact from the American and Japanese economic malaise. For this reason, current metal price doldrums are not likely to recover in the foreseeable future. As a result, many new mine development and re-development projects in Canada that were shelved since 1997 and subsequently revived for development since early 2000 have again been negatively affected and quiet postponements abound. Although there has been an improvement in both exploration and mine financing in 2001, rallied in part by improved demand for nickel and copper in late 2001, metal prices in general have fallen back in the second quarter of 2002.

However, amidst a depressed market for copper, zinc and lead, some bright spots do exist. Since March 2002, gold prices have recovered to above the US$300/oz mark. This gold price recovery has a significant effect on stimulating exploration and development and many gold development projects that were shelved in 2001 have again been revived. Should gold prices be sustained at US$320/oz or higher, many gold mines can be expected to open or re-open over the next two years. Platinum group metals, coal and diamond prices were also maintained at a relatively healthy level in 2001 and the first half of 2002, and the outlook for uranium and iron ore has also improved.

Still, an overall sustained global economic recovery is needed to stimulate demand for minerals and metals if we are to see improved prospects for mining across Canada. In view of the current worldwide geopolitical and economic uncertainty, the short-term outlook (less than two years) for significant new mine developments and mine openings in Canada is dim except for mines that have already been committed for production such as the Diavik and 777 projects. Only gold and uranium and, to some extent, diamonds have a somewhat more positive outlook.

Notes: (1) Information in this review, based mostly on company reports and communications with companies, was current as of June 30, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. MINE OPENINGS AND CLOSINGS IN CANADA, 2001

Province? Territory	New Mines			Mines Re-Opened			Mines Suspended			Mines Closed		
	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals	Precious Metals	Base Metals	Other Minerals/ Metals
Newfoundland and Labrador	1	–	–	–	–	–	–	–	–	1	–	–
Nova Scotia	–	–	–	–	–	–	–	–	–	–	–	1
New Brunswick	–	–	–	–	–	–	–	–	–	–	–	1
Quebec	–	–	–	–	–	–	1	–	–	1	–	1
Ontario	–	–	–	–	–	–	2	–	–	–	–	–
Manitoba	–	–	–	–	–	–	1	–	–	–	–	–
Saskatchewan	–	–	–	–	–	–	–	–	1	–	–	–
British Columbia	–	–	1	–	–	–	1	1	–	1	1	–
Yukon	–	–	–	–	–	–	1	–	–	–	–	–
Canada, total by commodity group	1	–	1	–	–	–	6	1	1	3	1	3
Total Canada		2			–			8			7	

Source: Natural Resources Canada, based on company reports.
– Nil.

TABLE 2. MINE OPENINGS, RE-OPENINGS, EXPANSIONS, EXTENSIONS, SUSPENSIONS AND CLOSURES IN CANADA IN 2001

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(tonnes/day)					
MINE OPENINGS								
Precious Metals								
Hammerdown	Baie Verte	Nfld.	375	50	July 3	U/G	Gold	Richmont Mines Inc.
Remarks: The Hammerdown gold mine near Baie Verte, Newfoundland and Labrador, began production on July 3, 2001. The mine was developed by Richmont Mines Inc. to replace its Nugget Pond mine some 140 km away. Ore from Hammerdown was trucked to the mill at Nugget Pond for processing. The Nugget Pond mine closed in December 2001 due to ore depletion. In 2001, estimated gold production from the Nugget Pond and Hammerdown mines totalled some 56 500 oz at a cash cost of about US$140/oz, with about 25 000 oz from Hammerdown. Planned annual gold output from Hammerdown is estimated at 50 000 oz. At the start of production in July 2001, ore reserves at the mine stood at 443 000 t grading 16.11 g/t (0.47 oz/st) gold, or 210 000 oz. The mine hosts an additional resource of 334 000 t grading 11.31 g/t (0.33 oz/st) gold, or 110 000 oz. The mine life is estimated at six years. The capital cost of developing the mine is estimated at about $10 million.								
Other Minerals								
Ashcroft	Ashcroft	B.C.	(e) 750	60	July	O/P	Basalt granules	I.K.O. Industries Ltd.
Remarks: The Ashcroft mine at Ashcroft, British Columbia, was brought on stream in July 2001, creating 60 mining jobs. The mine, developed at a capital cost of some $25 million-$30 million, is owned and operated by I.K.O. Industries Ltd. through a wholly owned subsidiary, I.G. Machines and Fibers Limited. Annual production of basalt roofing asphalt granules is planned at 250 000 t. At the start of production, mine reserves were estimated at about 18 Mt.								
EXPANSIONS AND EXTENSIONS								
Precious Metals								
LaRonde	Val-d'Or	Que.	4 550	360	1997-2004	U/G	Gold	Agnico-Eagle Mines Limited
Remarks: During the past 14 years, the daily ore production rate at the LaRonde gold mine has been expanded four times. But the recent discovery of extensive gold, silver, copper and zinc mineralization at depth enabled the mine to embark on its most ambitious capital expansion program. Phase 1 of this $218 million, two-phase program, which was originally announced in 1997 and subsequently revised, was completed at the end of 2000 with the completion of the Penna Shaft to a depth of 7065 m. At the same time, mill throughput increased to 4550 t/d from 3265 t/d. This facilitated the record production of 234 860 oz of gold in 2001, an increase of 35% over the previous year. The cash cost in 2001 was US$155/oz, an 18% decrease from the previous year. In 2001, capital expenditures amounted to $36.3 million, substantially lower than those of 2000 and 1999 of $68.4 million and $68.9 million, respectively, as most of the physical infrastructure for the expansion to 4550 t/d was completed prior to 2001. As of December 31, 2001, ore reserves stood at 33.03 Mt grading 3.08 g/t gold, 4.05% zinc, 0.36% copper and 78.86 g/t silver. Mineral resources stood at 30.6 Mt grading 5.48 g/t gold, 0.52% copper, 0.44% zinc and 22.97 g/t silver. Gold contents of the total reserves and resource amount to some 8.5 million oz, making the LaRonde mine the largest gold deposit in Canada and one of the largest in the world. The next phase of the expansion program will see mill capacity increased to 6370 t/d by the fourth quarter of 2002. Gold production in 2002 is expected to reach 340 000 oz at a cash cost of about US$130/oz. When the lower gold/copper-rich portions of the orebody are fully developed in the second half of 2003, annual gold production from the mine is expected to reach the 400 000-oz level at a cash cost below US$100/oz in 2004. Recent exploration has identified a potential new gold zone east of LaRonde on the El Coco property.								
Red Lake	Balmertown	Ont.	550	(e) 175	2000-2001	U/G	Gold	Goldcorp Inc.
Remarks: Since the re-opening of the Red Lake mine in August 2000, both production and ore reserves at the mine have grown considerably. In 2001, gold production from the mine, mainly from the High Grade Zone, was a record 503 385 oz at a cash cost of US$59/oz, significantly exceeded the original business plan (feasibility study) forecast annual production of 240 000 oz at a cash cost of US$88/oz. This makes Red Lake the largest gold-producing mine in Canada. The mine produced 85 115 oz of gold in 2000 - its first year of production resumption. For 2002, gold production from the Red Lake mine is forecast at 475 000 oz at a cash cost of less than US$70/oz. As of December 31, 2001, ore reserves in the High Grade Zone (HGZ) were 1.7 Mt grading 69.3 g/t (2.02 oz/st) gold, for a total of 3.78 million oz, an increase in gold content of 25% over 2000. The high-grade resources have grown to 430 000 t with a grade of 92.6 g/t (2.70 oz/st) gold, for a total of 1.28 million oz. The 2002 exploration program at the Red Lake mine will focus on the depth and east and west extensions of the HGZ, the extensions of the lower grade sulphide mineralization at depth, and the newly discovered Far East Zone.								

Lac des Iles	Thunder Bay	Ont.	2 400	275	2000-2002	O/P	Palladium, platinum, gold, copper, nickel	North American Palladium Ltd.

Remarks: Following an extensive exploration program in 1999 and a detailed feasibility study completed in May 2000, a $220 million expansion program was launched at the Lac des Iles mine to expand production. A new concentrator, which was completed in June 2001, boosted the ore throughput capacity from 2400 t/d to 15 000 t/d. Annual palladium production from the mine is expected to increase to 250 000 oz, or 5% of the world's annual palladium supply, by 2002. The mine life is estimated to be 17 years. However, throughput has been disappointing, caused by difficulties with the refurbished pebble crusher, unanticipated constraints with the flotation cleaner circuit, and the inability of the semi-autogenous grinding (SAG) mill to operate at the designed rate. A new, larger pebble crusher was installed in October 2001, resulting in finer material for the SAG mill. This, together with modifications to the grinding and flotation circuits, has improved mill throughput and recoveries. However, in the long run, a secondary crusher, modifications to the grinding circuit, and possibly an expansion of the flotation circuit would be needed. Since December 2001, the mine has undergone a cost-reduction and streamlining exercise to reduce mining operation and ancillary services with a work force reduction. The mine produces a single bulk concentrate containing palladium, platinum, gold, copper and nickel. The concentrate is trucked to Sudbury, Ontario, for smelting by Inco Limited and Falconbridge Limited, and then shipped to these companies' respective European operations for refining. In 2001, the faulted extension of the Main High Grade zone at depth was discovered, referred to as the "Offset High Grade" zone. The intercepts within this zone were exceptional with an average palladium grade of 5.2 g/t over a true thickness of 23 m. As of December 31, 2001, ore reserves were 93.5 Mt grading 1.53 g/t (4.6 million oz) palladium, 0.17 g/t platinum, 0.12 g/t gold, 0.06% copper and 0.05% nickel. Measured and indicated resources totalled 65.9 Mt grading 1.58 g/t (3.3 million oz) palladium, 0.17 g/t platinum, 0.11 g/t gold, 0.05% copper and 0.05% nickel. In addition, inferred resources totalled 73 Mt grading 1.57 g/t palladium, 0.15 g/t platinum, 0.10 g/t gold, 0.05% copper and 0.05% nickel. At full production, starting in 2002, annual output is expected to be 250 000 oz of palladium, 23 000 oz of platinum, 18 000 oz of gold, 6 million lb of copper and 2 million lb of nickel at a cash cost of US$200/oz of palladium. The mine currently employs 275 people, compared to 130 prior to the expansion. The Lac des Iles mine is Canada's only primary palladium mine.

Niobec	Chicoutimi	Que.	2 700		1998-2001	U/G	Niobium, ferroniobium	Cambior inc. and Mazarin Inc.

Remarks: A $15.7 million capital program, which started in 1998, to deepen the Niobec mine shaft to develop deep mineral reserves in the lower or third block, to develop a ramp, and to install a new crusher was substantially completed in early 2001. During 2001, capital expenditures were estimated to be $2 million, compared to $6.2 million in 2000 and $3.8 million in 1999. As of December 31, 2001, ore reserves at the mine stood at 18.2 Mt grading 0.68% Nb_2O_5 (niobium oxide), a 60% increase over 2000 (11.4 Mt grading 0.73% Nb_2O_5). More than 90% of the overall mineral reserves are located above level 1450 and can be mined using the current underground infrastructure. This will reduce the development costs required for their extraction. As a result of the substantial increase in ore reserves, the mine life is now estimated at over 16 years. Mill capacity, expanded at a capital cost of $4 million, was increased to 2700 t/d from 2400 t/d. Production in 2001 was 3006 t of niobium, a 20% increase over 2000. Niobec is the only producer of niobium in North America and is one of three important producers in the world. The mine produces a pyrochlore concentrate that is transformed into ferroniobium grading 66% niobium using an aluminothermic converter. The product is added to steel and various alloys to improve mechanical properties and corrosion resistance. In March 2001, Teck Corporation sold its 50% interest in the Niobec mine to Mazarin Inc. for $48 million. Mazarin is the mine operator while Cambior inc. is responsible for the worldwide marketing of the ferroniobium. In 2002, the partners plan to maintain the niobium production and capital investment levels of 2001, but are evaluating plans to gradually increase production by an additional 20% in order to maintain their market share as world use of ferroniobium is expected to increase.

Kidd Creek	Timmins	Ont.	12 500	(e) 950	2000-2004	U/G	Copper, zinc, silver	Falconbridge Limited

Remarks: The development of Mine D, a deep ore development program to extend the mine life at Kidd Creek, was accelerated in 2001. The $640 million mine extension project, which was announced in July 2000, is focused on development of the mine from a depth of 2100 m (6800 ft) to 3100 m (10 000 ft), giving access to an additional 10.3 Mt of reserves and 14.1 Mt of resources in two stages. As of December 31, 2001, ore reserves at the Kidd Creek mine, including Mine D, totalled 24.98 Mt grading 2.2% copper, 6.32% zinc and 68 g/t silver. The mine also hosted a small indicated resource of 348 000 t grading 2.06% copper, 6.69% zinc and 30 g/t silver, and an inferred resource of 14.15 Mt grading 3.35% copper, 4.90% zinc and 91 g/t silver, which came essentially from Mine D. In the development of Mine D, Stage 1 will take the mine from 2100 m to about 2700 m in depth and Stage 2 will take it to a depth of 3100 m. This will make Kidd Creek the deepest base-metal mine in the world. Overall, the Stage 1 portion of the mine contains about 15.7 Mt of ore grading 2.82% copper, 5.74% zinc and 58 g/t silver. The Stage 2 portion contains 10.5 Mt grading 2.20% copper, 5.27% zinc and 97 g/t silver. Work has begun on a new underground shaft that will go from about 1460 m to 3100 m. This new shaft will replace shaft no. 3 once Mine D is operational. Ore production from Mine D is planned at 2 Mt annually. The development of Mine D has been accelerated and the mine is expected to begin production in 2004. To date, the project is on budget and on schedule.

Creighton	Sudbury	Ont.	(e) 3 500	525	2001-2013 (Phase 1), 2005-2019 (Phase 2)	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: A US$125 million, two-phase capital program to extend the mine life and to expand mine production at the Creighton nickel mine in Sudbury, Ontario, continued in 2001. The Creighton Deep project, which was announced by Inco Limited in April 1998, aims to develop a 6-Mt high-grade, low-cost nickel-copper deposit at depth at the Creighton mine over the next two decades. Phase 1 of the project, from 2001 to 2013, which involves mine development between the 7400-ft and 7660-ft levels, will develop proven reserves of 2.8 Mt grading 3.45% nickel and 2.97% copper located between the 7400 and 7660 levels. Production from this ore, which was scheduled to begin in 2001, is expected to continue through 2013. Capital expenditures incurred on the project amounted to US$14 million in 2000. In Phase 2, development will extend to the 8180-ft level between 2005 and 2019, during which some 3.1 Mt of probable reserves grading 3.62% nickel and 3.25% copper will be developed and mined. In contrast, the current average grades of the Ontario Division mines are 1.3% nickel and 1.2% copper. When Creighton Deep is fully operational (originally planned for 2002), annual production is expected to be 10 900 t of nickel, 9500 t of copper and 28 000 oz of platinum group metals. The Creighton orebody was discovered in 1856. The mine, which began production in 1901, celebrated a century of continuous production in 2001. Creighton is Inco's oldest operating mine.

McCreedy East	Sudbury	Ont.	2 700	180	2000-2004	U/G	Nickel, copper, cobalt, precious metals	Inco Limited

Remarks: Since its opening in 1996, the McCreedy East nickel mine in Sudbury continued to expand production. Shortly after a $194 million expansion program to increase daily ore capacity to the 2700-t level was completed at year-end 1999, the discovery of a high-grade nickel deposit nearby prompted further plans to expand the operation. In June 2000, Inco Limited announced a new $46 million (US$33 million) capital program to develop this orebody. It will involve mine development of the Main and adjacent West orebodies containing 8 Mt grading 1.88% nickel, 0.84% copper and 0.91 g/t platinum group metals. Mine production is expected to increase to 4350 t/d from the current 2700 t/d when full production is reached in late 2004. At this rate, metal production will be 22 million kg (48 million lb) of nickel and 42 million kg (92 million lb) of copper annually, up from the current 13 million kg (29 million lb) of nickel and 37 million kg (82 million lb) of copper. The expansion of the McCreedy East mine will provide Inco's Ontario Division with another source of low-cost production for at least another 15 years. Further mine-life extensions are likely as the mine has other mineral zones with excellent potential. The McCreedy East mine is one of Inco's most productive mines with ore handling and materials transportation accessible by existing infrastructure at Inco's nearby Coleman mine. It has been designated by Inco as one of four key mines in its Ontario Division. The other three, Creighton, Copper Cliff North and Copper Cliff South, are all in the Sudbury area. These four mines are also the company's lowest-cost mines in Ontario.

TABLE 2 (cont'd)

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(tonnes/day)					
Stobie	Sudbury	Ont.	(e) 4 000	250	2000-2001	U/G	Nickel, copper, cobalt, precious metals	Inco Limited
Remarks: Inco Limited decided in 2000 to proceed with development of a low-grade component of the Stobie mine. This development, along with the related extension of the main portion of the Stobie mine, is expected to result in aggregate production of over 20 000 t/y of contained nickel from the mine over a period of 15 years starting in 2001.								
Birchtree	Thompson	Man.	1 635	150	2001-2002	U/G	Nickel, copper, cobalt, precious metals	Inco Limited
Remarks: In February 2000, Inco Limited announced a US$48 million ($70.4 million) capital program to extend the life of the Birchtree nickel mine near Thompson, Manitoba, to 2016. The two-year project will deepen the mine and increase production to 3175 t/d from 1635 t/d while reducing costs by approximately 25%. As well, ore reserves will increase to 13.6 Mt grading 1.79% nickel. This mine-life extension work was progressing as planned in 2001. The mine is expected to reach full production in 2004. A joint effort by a company/union co-design team made the deepening financially viable by redesigning the mine development plan to further lower costs and accelerate cash flow. The Birchtree mine operated from 1966 to 1977, returning to production most recently in 1989. Inco is also studying the deepening of its Thompson 1-D orebody and is re-surveying the entire Thompson Nickel Belt. Both activities are part of Inco's overall exploration strategy to focus on discovering new mineralization near current mines and previously known deposits. This strategy has proven to be successful in recent years.								
Other Commodities								
Carol Lake	Labrador City	Nfld.	(e) 49 500 (conc. and pellet)	n.a.	1998-2003	O/P	Iron	Iron Ore Company of Canada
Remarks: A $1.1 billion, six-year comprehensive capital investment program that started in October 1998 continued in 2001. About $650 million, or 60%, of the investment will be spent on upgrading and expanding the company's Carol Lake mine, concentrator and pellet plant near Labrador City. Another $361.5 million will be spent on reactivating the pellet plant at Sept-Îles, Quebec, which was mothballed in 1982. However, completion of the Sept-Îles iron pellet plant, originally scheduled for 2002, was postponed due to poor market conditions for iron ore in the first half of 2001. Although recent stabilization of iron ore prices may offer hope for the resumption of the Sept-Îles plant, better prices would be needed to put the overall investment program on track.								
MINE CLOSINGS								
Production Suspensions								
Precious Metals								
Sigma-Lamaque	Val-d'Or	Que.	3 000	90	February 14	U/G	Gold	McWatters Mining Inc.
Remarks: Production at the Sigma-Lamaque Complex was suspended in February 2001 due to high costs. Subsequently, owner McWatters Mining Inc. successfully obtained approval from the Superior Court of Quebec of a plan to restructure its shares, debts and other liabilities to stabilize the company's financial position. The plan has resulted in the reduction of McWatters' total indebtness from $30.2 million to $4.4 million, but at significant dilution for shareholders. In addition, SOQUEM INC. (part of the Société générale de financement du Québec (SGF) development agency that invests with the private sector to promote industrial development in Quebec) would acquire a 40% interest in Sigma-Lamaque for $20 million and would fund $5.8 million of the estimated $31 million capital cost for re-opening and expanding the mine. The agreement between McWatters and SOQUEM will be in the form of a limited partnership under which McWatters will be the mine's operator. The partnership is conditional on the transfer to SOQUEM of the rights to the $19.6 million of financing already secured by McWatters for the project from Investissement Québec ($17 million) and Canada Economic Development ($2.6 million). McWatters must also contribute $8.8 million in initial and working capital. The plan will include an expansion of the mill to 5000 t/d from the exisitng 3000 t/d. Production from the open-pit operation is scheduled to begin in the fourth quarter of 2002, reaching full production in the second half of 2003. Annual gold output is expected to be 150 000 oz over a seven-year mine life at an average total operating cost of US$212/oz.								
Edwards	Wawa	Ont.	(e) 250	(e) 51	July 5	U/G	Gold	River Gold Mines Ltd.
Remarks: Production at the Edwards gold mine near Wawa was suspended due to high costs. However, only small amounts of ore reserves are remaining and recent efforts to find more ore have not been successful. Owner River Gold Mines Ltd. intends to conduct further deep exploration on the property when gold prices are significantly more attractive.								

Glimmer	Matheson	Ont.	1 000	90	May 10	U/G	Gold	Exall Resources Limited and Glimmer Resources Inc.

Remarks: Production was suspended in May 2001 at the Glimmer gold mine due to depressed gold prices. The joint-venture partners were negotiating financing with a view to restarting production. In 2000, Glimmer and Exall resolved litigation between the two companies relating to proportional ownership interests in the mine.

Bissett	170 km NE of Winnipeg	Man.	1 000	230	August	U/G	Gold	Harmony Gold Mining Company Limited

Remarks: Production at the Bissett gold mine in Manitoba was suspended in August 2001 due to high costs and weak gold prices. Harmony Gold Mining Company, a South African-based company, bought the mine from bankrupt Rea Gold Corporation in mid-1998 and commissioned the 1000-t/d mill in October that year.

Mount Polley	Williams Lake	B.C.	18 000	250	September	O/P	Gold, copper	Imperial Metals Corporation

Remarks: Production was suspended in September 2001 due to weak metal prices. About 10 workers were kept on site for care and maintenance.

Brewery Creek	Dawson City	Y.T.	(e) 11 000	70	December	O/P & HL	Gold, silver	Viceroy Resource Corporation

Remarks: Mining was suspended in late 2000 due to weak gold prices. However, gold production continued in 2001 through heap leaching. Seasonal mining operated an average of 210 days a year. The leach plant has a load capacity of 11 000 t/d. As of December 31, the mine was without mineable reserves and the remaining measured and indicated resources stood at 92 000 t grading 1.45 g/t gold containing 43 000 oz of gold. Planned mine reclamation work will be funded by more than $8 million in cash deposits already set aside by mine owner Viceroy Resource Corporation.

Base Metals

Myra Falls	Campbell River	B.C.	4 000	439	December	U/G	Zinc, copper, gold	Boliden Limited

Remarks: Production was suspended in early December 2001 due to weak metal prices. After an agreement had been reached with employees, unions, suppliers and customers regarding an extensive action plan to improve operating efficiency, a decision was made to re-open the mine in March 2002. Under the plan, the work force will be reduced by approximately 17% and wages, salaries and contracts with suppliers and contractors will be adjusted. The Myra Falls mine has been in production for 36 years and has been owned and operated by Boliden since 1998.

Other Minerals

Rabbit Lake (2)	Rabbit Lake	Sask.	1 000	100	June	Surface stockpile	Uranium	Cameco Corporation

Remarks: Mining was suspended in 1999 and 2000 and the shut-down was extended to 2001 in the wake of continued weak world uranium prices. However, milling continued to process stockpiled ore until June 2001. About 50 of the 150 employees were kept on site. Plans were to re-open the Eagle Point mine for production in 2002.

Closures

Precious Metals

Nugget Pond	Baie Verte	Nfld.	350	61	December	U/G	Gold	Richmont Mines Inc.

Remarks: Mine closed in December 2001 due to ore exhaustion. The mine began production in April 1997.

Francoeur	Rouyn-Noranda	Que.	1 225	62	November 30	U/G	Gold	Richmont Mines Inc.

Remarks: Mine closed on November 30, 2001, due to ore exhaustion. The mine began production in October 1991.

Golden Bear	Dease Lake	B.C.	360	70	December	O/P, U/G, HL	Gold	Wheaton River Minerals Ltd.

Remarks: The Golden Bear gold mine, located some 150 km west of Dease Lake in northern B.C., closed in late 2001 due to ore depletion. The mine first began production in November 1989 and was a conventional open-pit and underground mine until 1997 when it became the first heap leach mining operation in B.C.

Base Metals

Sullivan	Kimberley	B.C.	9 000	444	December 21	U/G	Zinc, lead, silver	Teck Cominco Limited

Remarks: After 92 years of active production, the world-class Sullivan mine closed on December 21, 2001. The deposit was discovered in 1892 and was acquired and developed for production in 1909 by Cominco Ltd (formerly the Consolidated Mining and Smelting Company of Canada). About 31 workers were kept on site for maintenance and environmental work.

TABLE 2 (cont'd)

Mining Project/Remarks	Location	Province/ Territory	Capacity	Employment During Mine Life	Date of Opening, Re-Opening, Expansion, Extension, Suspension or Closure	Mine or Plant Type	Main Commodities	Company
			(tonnes/day)					
Other Minerals								
Prince	Sydney	N.S.	3 850	440	November 16	U/G	Coal	Cape Breton Development Corporation
Remarks: The Prince coal mine near Sydney, Nova Scotia, closed in November 2001 as the company failed to secure a buyer for this high-cost mine. The mine, together with the Phalen mine nearby which was closed in December 1999, is part of a federal corporation established in the late 1960s to wean Cape Breton away from coal mining. That goal changed with the energy crisis of the early 1970s and coal was given a reprieve. But the operations had been plagued by problems ever since, losing an estimated $1.8 billion over the past 30 years. The Prince mine began production in August 1975.								
Coal Creek	Minto	N.B.	(e) 470	20	August	O/P	Coal	N.B. Coal Limited
Remarks: The Coal Creek coal mine closed in August 2001 due to pit ore depletion. It was one of N.B. Coal Limited's two last producing coal mines near Minto, New Brunswick. The Salmon Harbour open-pit mine is the company's remaining coal mine; it supplies thermal coal to a nearby NB Power plant.								
Luzenac	Saint-Pierre-de-Broughton	Que.	(e) 165	(e) 25	April 24	O/P	Talc, soapstone	Luzenac Inc.
Remarks: Mine closed on April 24, 2001, due to the discovery of asbestos fibre in talc concentrates. The number of workers at the talc and soapstone operations in 2000 was estimated at 14 and 13, respectively.								

Source: Natural Resources Canada, based on company reports and communications with companies (information current as of March 31, 2002).

(e) Estimate; HL Heap Leach; n.a. Not available; O/P Open pit; U/G Underground.

(1) In most cases of mine closings, employment represents the number of employees at the time of closing of the mine and the mill. (2) Due to weak uranium prices, mining at the Eagle Point uranium mine at Rabbit Lake was suspended in 1999 and 2000 and the shut-down was later extended to cover 2001 to synchronize with the shut-down of the Rabbit Lake mill in June 2001.

TABLE 3. NEW PRODUCTION FROM MINE OPENINGS IN CANADA IN 2001

		Estimated Annual Production			
Mining Project	Main Commodities	Gold	Gold	Zinc	Basalt Roofing Granules
		(oz)	(g)	(t)	(t)
NEW OPERATIONS					
Precious Metals					
Hammerdown	Gold	50 000	1 555 000	–	–
Other Mineral Commodities					
Ashcroft	Basalt roofing granules	–	–	–	250 000

Source: Natural Resources Canada, based on company reports and communications with provinces.
– Nil.

TABLE 4. NEW MINERAL RESERVES FROM MINE OPENINGS IN CANADA IN 2001

	Proven-Probable Mineral Reserves			In-Situ Metal Reserves			
Mining Project	Main Commodities	Tonnage	Grade	Gold	Gold	Zinc	Basalt Granules
		(tonnes)		(oz)	(g)	(t)	(t)
NEW OPERATIONS							
Precious Metals							
Hammerdown	Gold	(e) 388 700	16.11 g/t gold	201 300	6 261 900	–	–
Other Mineral Commodities							
Ashcroft	Basalt roofing granules						18 000 000

Source: Natural Resources Canada, based on company reports and communications with provinces.
– Nil; (e) Estimated.

International Scene

Prepared by the Minerals and Metals Sector, Natural Resources Canada.

One of the priorities identified in Natural Resources Canada's (NRCan) 2001 Departmental Sustainable Development Strategy is to internationally promote Canadian sustainable development practices.

The Government of Canada's *Minerals and Metals Policy* echoes this departmental priority by promoting international consensus-building and cooperation on sustainable development policies, goals and actions. In 2001, the international activities of NRCan's Minerals and Metals Sector (MMS) included:

- bilateral, regional and international policy development;
- science and technology transfer and capacity building;
- international business development; and
- investment activities.

The activities and partnerships that have been developed (some of which are outlined below) provide an opportunity for MMS to demonstrate Canadian know-how and expertise in a wide range of issues related to sustainable development, such as the safe use of minerals and metals, life-cycle analysis, product stewardship, science-based decision-making, and advances in science and technology related to mining technology, the mitigation of environmental impacts of mineral and metal development, and mine closure and site reclamation. In addition, Canada's exploration, mining, and mining-related equipment and services industries are supported by MMS's participation in international trade and investment activities/business development and the promotion of opportunities for joint ventures with Canadian companies.

INTERNATIONAL TRADE DEVELOPMENT

Expo-Minería, Acapulco, Mexico

As part of an effort to help Canadian small and medium enterprises (SMEs) access new markets, a decision was taken to participate in selected international trade shows. The Minister's mission to Mexico provided NRCan with the first opportunity for a presence at the Expo-Minería trade show, which took place October 17-21, 2001, in Acapulco. In all, about 50 companies were represented in the Canada pavilion, which was inaugurated by the Minister of Natural Resources. The pavilion was organized by the Canadian Association of Mining Equipment and Services for Export (CAMESE). Other Canadian exhibitors were located with their Mexican distributors. Many Mexican participants were keen to establish contact with Canadian companies through the Canadian government in order to explore business opportunities. Mexican State authorities were most interested in finding ways to attract Canadian exploration companies back to Mexico. Minister Goodale was also invited to be a guest speaker at the official opening ceremonies where he delivered a well-received address on the importance of Mexico to Canada's trade and investment community. The Minister was also invited by Mexican authorities to witness the signing of an agreement promoting mining between the Mexican federal government and the government of the State of Guerrero.

During Expo-Minería, Canadian government representatives held several meetings with Mexican authorities who seemed to be very interested in issues related to the sustainable development of minerals and metals and the tax treatment of trust funds and flow-through shares.

First EXPOMIN Trade Show in the Dominican Republic

The VI CAMMA meeting held in Santo Domingo, Dominican Republic, was the occasion for that country to organize its first international mining trade show. EXPOMIN took place November 21-24, 2001, and included international participants such as Cuba, Ecuador, Mexico, Australia and Canada. The only Canadian mining company operating in the Dominican Republic, Falconbridge Dominicana, C. por A., a subsidiary of Falconbridge Limited, was also present. Dominican authorities took advantage of this opportunity to declare the whole week "mining week" and to disseminate knowledge about minerals and metals in schools across the country. Some key contacts were also established with professionals from the Dominican Republic and from Haiti.

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GLOBAL PARTNERSHIPS

World Summit on Sustainable Development (WSSD)

The WSSD will be held in Johannesburg, South Africa, in August/September 2002 to mark the 10th anniversary of the United Nations Conference on Environment and Development (UNCED). As part of the preparations for the WSSD, a series of regional intergovernmental meetings were held in the fall of 2001. These meetings took place in the European/North American, Latin American/Caribbean, Asia-Pacific, West Asia and African regions and were intended to identify regional and global priorities for the WSSD. The management of natural resources was a common theme in most meetings with a number of regions identifying minerals and metals as an area for which the Summit should develop specific initiatives.

This finding builds on a decision adopted in 2000 by the Commission on Sustainable Development (CSD), the United Nations body established to follow up on the UNCED outcomes. That decision identified "minerals, metals and rehabilitation in the context of sustainable development" as a priority area for future work and urged "governments, the international community and other relevant actors . . . to examine the social, economic, and environmental impacts of minerals extraction and metals production . . ."

Also as part of the WSSD preparations, Canada, together with South Africa and other governments, is promoting a global dialogue on mining, minerals, metals and sustainable development as a WSSD outcome. The dialogue would examine the manner in which governments can most effectively promote the life-cycle contribution of the sector to sustainable development, including a focus on communities.

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The Non-Ferrous Metals Consultative Forum on Sustainable Development

Recognizing the important contribution that nonferrous metals can make to the overall sustainable development of society, the 38 member countries of the three international metal study groups (the International Copper Study Group, the International Lead and Zinc Study Group, and the International Nickel Study Group) initiated a multi-stakeholder process in 1999 to address issues related to the mining, production, use and recycling of nonferrous metals.

The first meeting of the Consultative Forum convened in Brussels in September 2000 to take forward the outcomes of the London Workshop. Priorities were set and six priority areas were identified:

- Stewardship programs;
- Community consultation and involvement;
- Promotion of recycling;
- Research and development;
- Open and transparent mechanisms to improve communication; and
- Information development and dissemination for decision-making.

To address these issues in the most efficient way, three Working Groups were established to take the work forward:

- Production of Nonferrous Metals;
- Product Stewardship; and
- Science, Research and Development.

Each Working Group is co-chaired by a representative from government, industry and civil society. The Study Groups provide secretariat support to each Working Group. Currently, some 15 countries, 15 industry associations, 25 companies, 15 NGOs and academics, and 3 United Nations-based organizations are actively participating in the work plans of the Working Groups. Membership in the Working Groups is open to any organization with an interest in mining, minerals and metals, and sustainable development.

The Working Groups continue to implement their work programs as outlined to the Forum in Porto, Portugal, in November 2001. Forum participants continue to seek opportunities to broaden participation in the activities of the Forum and to build partnerships with others with an interest in mining, metals and sustainable development.

More information about the Consultative Forum, its activities and accomplishments to date, and future activities of the Working Groups can be obtained through the Forum's web site at www.nfmsd.org or by contacting the Study Group Secretariats.

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REGIONAL PARTNERSHIPS

Latin America and the Caribbean

CAMMA Mission Statement

Recognizing the important contribution of mining to the development of our respective economies; acknowledging the role that the sustainable development of minerals and metals can have in alleviating poverty and improving the well-being of our communities while minimizing the environmental impacts of mining development, we, as Mining Ministries in the Americas, are committed to supporting and promoting the implementation of policies which take into account environmental, social and economical considerations in government decision-making, supported by scientific-based knowledge, and which will foster the development, promotion, sound management, and safe use of minerals and metals in the Americas.

In the Americas and the Caribbean, the Minerals and Metals Sector (MMS) is achieving the goals of the CAMMA Mission Statement through the implementation of collaborative activities, policy development and strategies within the Annual Mines Ministries of the Americas Conference (CAMMA). CAMMA is a ministerial-level mining policy forum that provides Ministers and senior mining officials, from 23 member countries, with opportunities to discuss mining policy and program issues, share best practices, develop common approaches to opportunities and challenges faced by the sector, and identify areas for future collaboration and research. As the Executing Agent of a five-year project sponsored by the Canadian International Development Agency, NRCan has played a leading role within CAMMA participating on the Coordinating Committee for the past four years, acting as Executive Secretariat (2000-2001) and host for the V CAMMA ministerial meeting in 2000, and co-hosting several workshops.

In March 2001, MMS hosted an international workshop for CAMMA, on mining and communities, to gain a regional and multi-stakeholder perspective on the roles of various stakeholders and their potential contribution towards community capacity building and sustainable communities following mine closure. This multi-stakeholder dialogue was designed to lead to more collaborative projects between CAMMA and stakeholders.

Consensus-building among like-minded countries within CAMMA resulted in minerals and metals being recognized in a sustainable development context, for the first time, within the Summit of the Americas process. As a result, the Action Plan of the 3rd Summit of the Americas, held in Québec City, Canada, in April 2001, saw the commitment of Leaders and Heads of State to "Promote the development of environmentally sound exploitation and management of minerals and metals, recognizing the importance of the social and economic dimensions of the activities of the mining sector, and support the work of regional and international fora in this area."

In June 2001, during the CAMMA officials meeting of experts, MMS, the Government of Manitoba, and a representative from the Canadian Aboriginal Minerals Association contributed to the discussions on sustainable development and mine closure. In addition, a number of presentations were made on the federal mandate and provincial regulations in Manitoba.

In November 2001, MMS participated in the VI CAMMA ministerial conference hosted by the Dominican Republic. NRCan will be working with CAMMA members to fulfill the mandate from Ministers vis-à-vis CAMMA's participation in and contribution to the 2002 World Summit on Sustainable Development and to review the role and contribution that CAMMA countries may play with respect to the Free Trade Area of the Americas. As mandated in the VI CAMMA *Santo Domingo Declaration,* NRCan will participate on the Coordinating Committee as Advisor to the Executive Secretariat for 2002-03; will lead a multi-stakeholder working group on Mining and Communities; leads the International Working Group; and will continue to maintain responsibility for the CAMMA web site at www.camma.org.

CAMMA has served to focus the resources of mines ministries in the Americas and the Caribbean so that advancements can be made on social, environmental and economic issues affecting civil society and local communities in the hemisphere; it has also contributed to the development of common sustainable development approaches and policies in member countries. The sustainable development policies being discussed in CAMMA are consistent with *The Minerals and Metals Policy of the Government of Canada: Partnerships for Sustainable Development.* CAMMA has also aided in reinforcing the connectivity between science and policy, another departmental objective, by underscoring the importance of sound science in government decision-making and the safe use principle for minerals and metals.

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APEC-Expert Group on Mineral and Energy Exploration and Development (GEMEED)

The economies of APEC include not only major producers of minerals and metals, but also major users of metals and mineral products. For a number of these economies, mining is a significant economic activity. In a global context, APEC supplies 79% of copper, 62% of gold, 69% of nickel and 73% of zinc, and receives nearly 75% of mining investment. Many economies, as a result, have a direct interest in the long-term viability of the minerals and metals sector.

GEMEED, which is part of the APEC Energy Working Group (EWG), was formed in 1995. It remains the only forum for governments to discuss minerals and metals issues in the APEC region. Since its formation, it has moved from a primarily economic focus to one of sustainable development, as reflected in its revised terms of reference. Its objectives are:

- to work to enhance the contribution of mineral and energy resources to sustainable development, through environmentally and socially acceptable practices in exploration and development; and

- to identify, develop and promote synergies in the area of mineral and energy exploration and development with other national, regional and multilateral organizations.

In recent years, GEMEED has organized Environmental Cooperation Workshops (known as ECOWs), as well as its regular annual meetings. In addition, it is undertaking several projects related to investment promotion, supply and demand for selected minerals, life-cycle assessment (LCA) of metals, and the role of government and the private sector in reclaiming abandoned mines (United States).

In 2001, GEMEED's principal achievements were:

- ensuring the inclusion of minerals and metals in the revised objectives and work plan of the EWG;

- holding ECOW 2001, hosted by Mexico, which addressed two themes: global challenges for the minerals and metals industry, and approaches in the APEC region to dealing with abandoned mines and mine closure; and

- supporting activities of The Society of Environmental Toxicology and Chemistry (SETAC) and Asia LCA Workshop held in Tokyo, Japan.

In 2002, GEMEED will be:

- supporting an international workshop on life-cycle assessment for metals, organized by UNEP/SETAC, the International Council on Metals and Mining (ICMM), and NRCan, which will be held in Montréal in April 2002;

- holding ECOW 2002, on indigenous peoples and mining, to be hosted by the United States; and

- holding its 7th Plenary Meeting in China in October 2002.

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PARTNERSHIPS IN SCIENCE AND TECHNOLOGY

International Technology Transfer and Capacity Building Projects of CANMET-MMSL

The Mining and Mineral Sciences Laboratories (MMSL) of NRCan is involved in delivering technology transfer and capacity-building projects in South America and Africa. MMSL is currently the executing agency on behalf of the Canadian International Development Agency (CIDA) for three such projects in Zambia, Guyana and Brazil. Each of the projects focuses on environmental management of the mining sector and involves transfer of technology from Canada to national governments, industry associations, non-governmental organizations, academic institutions and environmental agencies in the partner countries. A multi-stakeholder approach is used in all of the projects to ensure sector-wide impact and sustainability of results.

Technology transfer takes place through a variety of means, including training programs both in Canada and locally in the partner countries, workshops, seminars, demonstration sites, and the carrying out of environmental surveys. Where possible, training takes the form of practical exercises in order to provide the trainees with hands-on experience to develop concrete and applicable skills.

While MMSL acts as the executing agency in partnership with CIDA, the projects involve the Canadian private sector, the academic community, other government departments, and provincial/territorial governments in the delivery of various project activities, and they serve to develop linkages between the mining sectors of the partner countries and the Canadian mining industry.

The role of MMSL in delivering these projects is to promote the principles of sustainable development of the mining and minerals sector globally. The projects also support CIDA's development mandate; aid in creating a level playing field for Canadian mineral producers; support Canada's reputation for environmental responsibility and expertise; open doors for Canadian subcontractors; serve to develop linkages between the mining sectors of the partner countries and the Canadian mining industry; and showcase Canadian services and capabilities in environmental technologies.

Environmental Management of the Mining Sector in Zambia (EMMS)

CANMET-MMSL is the executing agency for the four-year CIDA-funded project on Environmental Management in the Mining Sector (EMMS) in Zambia. The goal of the EMMS project is to improve environmental management practices in the mining sector in Zambia, principally by strengthening the institutional capacity of the Mines Safety Department (MSD) of the Ministry of Mines and Minerals Development (MMMD) and other designated institutions to regulate and monitor environmental management while at the same time building knowledge of environmental management amongst Zambian mining companies. The project works with other key mining sector institutions such as the Environmental Council of Zambia (ECZ), ZCCM Investment Holding Plc, the University of Zambia, and Copperbelt University.

The project maintains excellent working relationships with the Zambian stakeholders (both public and private sectors).

A Canadian in-country manager was deployed to Zambia in March 2001 and has established a project office within the Mines Safety Department in Kitwe. While the main focus for year one of the project was the mobilization of the in-country manager and the establishment of the office, other activities during the first year included visits by two delegations from Zambia who toured mine regulatory agencies and mine sites in both British Columbia and Ontario. This exposed a number of Zambians to Canadian regulatory structures and the environmental technologies being utilized by mining companies operating in Canada. These tours were very useful in demonstrating the range of both CANMET's and Canada's experience and expertise in mining. A reciprocal visit to Zambia by a Canadian regulator resulted in a greater understanding of the situation in Zambia, which will be of great assistance in designing relevant follow-up programs and short-term placements in Canada for Zambian participants.

While the project is in year two of its implementation, the project in-country manager is already recognized within Zambia as an authority on matters related to mining and the environment. As an example of the project's impact to date, the in-country manager, along with representatives from the World Bank, raised concerns over the imminent failure of a series of tailings dams at an inactive mine. As a result of continued discussion and site visits with MSD and ZCCM staff, MSD was convinced to issue a control order to ZCCM, who has ultimate responsibility for the site, that remedial work should be undertaken immediately. Work on the site began the day after the site visit.

Other proposed project activities will largely target issues surrounding SO_2 emissions and the establishment of an ambient air quality monitoring network. This will include training on the set-up and maintenance of monitoring equipment with training provided by consultants and placements in Canada. Water quality monitoring will also begin to be addressed through the selection of several strategic monitoring stations. Water monitoring in Zambia is a little more challenging than in Canada, largely because of the abundance of Nile crocodiles. As a result, people (including regulators) are generally afraid of the water and, since boats are quite uncommon, monitoring stations will generally be limited to bridges or other safe locations. In addition, a Resource and Revenue Assessment will attempt to develop a more strategic direction and scope of services for MSD, based in large part on the needs of industry.

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Guyana Environmental Capacity Development Project (GENCAPD)

The GENCAPD project is designed to develop environmental expertise in several of the key institutions involved with the mining sector in Guyana and to develop a regulatory framework that will promote the sustainable development of Guyana's mineral resources.

This six-year, $3.75 million project, financed by CIDA, focuses on developing technical and managerial capacity within the key mining sector institutions of Guyana, including the Guyana Geology and Mines Commission (GGMC), the Environmental Protection Agency (EPA), and the Guyana Gold and Diamond

Miners Association (GGDMA). The University of Guyana also plays a role in the project.

The focus of the project is on systems and human resource development with long- and short-term technical and professional training in both Canada and Guyana. MMSL employs a number of Canadian consultants to conduct training, to participate in environmental surveys, and to lead demonstration projects in Guyana.

The project focuses on three main areas:

- **Policy and Regulation**: The project has carried out an assessment of the existing regulatory framework and the initiation of a multi-stakeholder process in which both government agencies and Guyana's mining industry participate to recommend necessary changes. New mining environmental regulations are due to be passed by Parliament this year and tools, such as codes of practice and environmental limits and guidelines, will be provided to the mining sector. GGMC has now acquired the expertise to conduct its own environmental surveys; turbidity plumes related to small-scale gold and diamond mining, and populations at risk due to the presence of methyl-mercury in their diet (fish) are now being monitored.

- **Monitoring and Inspection**: The project is developing the capacity of relevant government institutions to mount and sustain a viable inspection program and provides training and other support necessary to achieve effective inspection. The project is also working on setting up graduate studies programs at the University of Guyana and increasing quality control at the Institute of Applied Science and Technology (IAST).

- **Operational Capacity Within Industry**: The project is improving productivity and reducing the environmental impact of mining activity in the interior. New technologies for maximizing mineral recovery in an environmentally responsible manner have been introduced through training and also through demonstration projects that target primarily small- and medium-sized mining ventures. The industry has already been provided with demonstrations for both gold and diamond recovery. Despite the fact that improved recovery techniques were demonstrated, miners remain unwilling to make the change. This is a challenge that the project will continue to address.

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Mine Rehabilitation Project – Brazil

Since September 1998, MMSL has been the delivery agent for CIDA for a project in Brazil on mine rehabilitation. Through this program MMSL has managed the transfer of expertise to a Brazilian government laboratory (Centro de Technologia Mineral [CETEM]) to assist it in implementing the application of mined land reclamation by the Brazilian mining industry.

For Brazil, the project has been extremely successful in achieving its goals of strengthening the institutional technical capability and fostering the improvement of mine-site rehabilitation practices in its minerals sector. The project has served to strengthen the awareness of the necessity of mine-site rehabilitation planning in Brazil. Increased private and public linkages between Canada and Brazil in the minerals sector have also evolved. Based on the Canadian model, success has also been achieved in promoting a multi-stakeholder approach to developing and executing mine rehabilitation projects. New links have also been forged between the Brazilian mining industry and government representatives.

Because mine rehabilitation activities are multidisciplinary in nature, technology transfer is achieved through a number of modes. The project has moved far beyond passive technology transfer to active skills development through the application of transferred knowledge at existing problem sites. Skills development is achieved through case history studies, focussed site demonstrations, the implementation of laboratory studies to derive the parameters required for site rehabilitation procedures, and the creation of multi-stakeholder groups working on well-defined rehabilitation tasks. More recently, the use of modeling tools to simulate "what if" situations has proven to be a very effective tool for planning aspects of mine rehabilitation.

The project was based on a proposal to CIDA by MMSL researcher Errol van Huyssteen. Since then, he has led the project and has been responsible for its management. However, the project has involved many others in its delivery, including a number of Canadian consulting companies and MMSL scientists Douglas Gould, Jennifer Nadeau, Anoop Kapoor, David Koren and Gilles Tremblay.

Sound technology has been the core of the project. The multi-disciplinary nature of mine rehabilitation is demonstrated by the breadth of the technical scope of the project. The comprehensive training has covered 30 areas. These include studies and activities in the areas of dam stability; establishing related site water balances; rehabilitation and revegetation; slope stability/related coal waste issues; natural degradation of oil-saturated soils; effluent treatment technologies; hydrology case histories; soil cover design;

ISO 14 000 - Environmental Management Systems; hydrogeology; surface water monitoring; receiving environment characterization; aquatic toxicology; surface water modeling tools; rehabilitation hydrology; tracer studies for groundwater pollutant tracking; risk analysis (air pollution, surface water pollution, groundwater pollution, health risk, and ecological risk); risk and crisis management; acid mine drainage (AMD) (treatment, calculation of reagent dosages for AMD neutralization, passive effluent treatment options for AMD); and the general principles of financial assurance options for site rehabilitation.

As a result of this program, a permanent mine-site rehabilitation program has been established at CETEM. It consists of 14 members with training in a wide range of disciplines. This team is now independently undertaking rehabilitation projects across Brazil. As well, more than 10 different operating mines in the state of Santa Catarina and three base-metal mining companies in the state of Minas Gerais are participating in the program. Equally important has been the building of links between various Brazilian organizations with responsibilities for mine rehabilitation, such as CETEM, state and national mining associations, individual mining companies, and state and federal regulatory officials. The project has successfully fostered the Canadian collegial approach to resolving environmental problems in the minerals sector, which should permit the Brazilians to continue to make significant progress in resolving their mine restoration problems.

Recent reviews of the project by CIDA have been quite favourable and, in fact, a one-year extension to the project has been funded to address some gaps in the current training and to provide the Brazilians with the tools for establishing consortia. The project will finish in June 2003.

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INVESTMENT ACTIVITIES

Canada-Russia Mining Working Group

MMS has been playing a leading role in the Mining Working Group of the Canada-Russia Intergovernmental Economic Commission (IEC) since it was created in 1998. The working group has been successful in raising the concerns of Canadian mining companies with high-level Russian government representatives, in holding a number of well-attended investment seminars in Toronto, Moscow and St. Petersburg, and in facilitating the negotiation of bilateral agreements regarding investment and geoscience collaboration.

The Mining Working Group hosted two major events in 2001. The Seminar on Investing in Northern Russian Resources: Regional Economic Perspectives and Mining Legislation Development was held in Toronto on March 15, 2001, in conjunction with the annual conference of the Prospectors and Developers Association of Canada. The Seminar was organized jointly with the Department of Indian Affairs and Northern Development, the Department of Foreign Affairs and International Trade, and the Canada-Russia Business Forum, and covered the economic, legal and social aspects of investing in northern Russia.

In November 2001, Ottawa was the host of a Plenary Session of the IEC. On that occasion, the Mining Working Group held a meeting attended by representatives of Canadian and Russian mining companies, equipment and services suppliers, and officials from both countries' governments. This meeting took place as part of a working session of the IEC where four other working groups also met (Agriculture, Fuels and Energy, Construction, and the Arctic and the North). Designated representatives from each working group were then invited to appear before the IEC co-chairs, the Honourable Pierre Pettigrew, Minister of International Trade for Canada, and his Excellency Viktor B. Khristenko, Deputy Prime Minister of the Russian Federation responsible for economic development and trade, and to present their recommendations for improved investment relations between the two countries. Matters discussed during the working group sessions and at the Plenary were integrated into an Action Plan in preparation for the Prime Minister's February 2002 Team Canada visit to Moscow.

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Mission to Korea and Japan (March 28-April 4, 2001)

MMS led a combined public and private sector mission of senior executives (Department of Foreign Affairs and International Trade, Indian and Northern Affairs Canada, the governments of the Northwest Territories and Yukon, the Quebec Prospectors Association, Teck Corporation, PricewaterhouseCoopers, Davis & Company, Expatriate Resources Ltd., Nuna Logistics) to Korea and Japan. The mission, a follow-up to Minister Goodale's visit, included meetings with key public and private sector decision-makers such as the Korean Ministry of Commerce, Industry and Energy; Korea Resources Corporation (KORES); Korea Zinc Co. Ltd.; the Japanese Ministry of Economy, Trade and Industry; and the Metal Mining Agency of Japan. It also included two well-received seminars. Seminar attendance in Seoul numbered around 60 people while the Tokyo event brought in around 75. Nineteen of the twenty individuals who completed an evaluation form in Seoul stated that the workshop met or exceeded their expectations.

In conjunction with the mission and the Tokyo Embassy's "Think Canada" festival, Teck Corporation sponsored a partial display of the Pinch collection. According to Embassy officials, on the weekend following the mining workshop, over 20 000 individuals visited the collection in the Canadian Embassy. The mission resulted in tangible Korean and Japanese interest in Canadian projects and a commitment from KORES that the company will open an office in Canada.

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International Lead and Zinc Study Group

The International Lead and Zinc Study Group (ILZSG) is an intergovernmental body responsible for providing maximum transparency for the markets in lead and zinc concentrate and refined metal. Particular attention is given to disseminating information on the supply and demand position for these metals and their probable development on a continuing basis.

MMS's Minerals and Mining Statistics Division (MMSD) possesses unique expertise in systems development and web site creation (and is also responsible for collecting, compiling, analyzing and publishing statistical information on Canadian mining activities) and will continue to collaborate with the ILZSG, which has responsibilities for providing its members with accurate and timely information.

Since August 1999, agreements have been signed between ILZSG and MMSD for the provision of ongoing electronic capabilities and for the delivery of a fully operational web site for the ILZG office in London, England. The system built by MMSD provides ILZSG with historical monthly data. The agreement continues in 2002, with further web development and maintenance service provided by MMSD. Similar services are also provided to the International Copper Study Group.

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MMS Officials Continue to Advance Relations With China Following Minister Goodale's Trade and Investment Mission to That Country in January 2000

As follow-up to Minister Goodale's trade and investment mission to China in January 2000, MMS's Economic and Financial Analysis Branch (EFAB) continued to advance NRCan's ongoing effort to further China's progress in fiscal and regulatory reform in its mining sector. This year, for the second time, NRCan participated in the Queen's University Department of Geological Sciences and Geological Engineering Executive Training Program for Senior Chinese Government Mining Officials (August 2001).

Two lectures were given dealing with:

- the roles and responsibilities of Canadian federal and provincial/territorial governments in mineral policy development in Canada, and how the Canadian model might be useful to China; and
- mine development and the mining-related regulatory process in Canada compared to the Chinese system. This second lecture was a new request from Queen's University.

Lectures were given to 21 senior Chinese officials (Director and Director General-level officials) and three interns from the Ministry of Land and Resources, Beijing, and provincial and autonomous regional governments. The lectures were followed by roundtable discussion sessions between Chinese officials and the lecturers.

Many Canadian mining companies are actively pursuing projects in China and welcome NRCan's efforts aimed at improving China's mining investment climate and Canada-China mineral relations.

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Notes: (1) Information in this review was current as of July 18, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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Canada's Global Mining Presence

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GLOBAL MARKET FOR MINERAL EXPLORATION

In 2001, the value of exploration programs planned around the world by companies of all sizes for precious metals, base metals and diamonds stood at an estimated $3.4 billion (US$2.2 billion), down by more than 10% from the $3.8 billion (US$2.6 billion) planned the previous year.[1] Exploration programs were reduced in about two-thirds of the countries and were postponed or abandoned entirely in others. Only in one country, Namibia, was an increase in exploration budgets of more than $10 million expected from 2000 to 2001.

WORLD'S LARGER COMPANIES

Global trends in mineral exploration are based on data for the world's larger mining companies.[2] These companies are defined here as those with annual exploration budgets of more than $4.6 million in 2001 (constant US$3 million annually). The larger companies are the only ones for which there are consistent data on worldwide exploration activity spanning a period of 10 years. In 2001, 98 companies based around the world each planned to spend more than $4.6 million on exploration. In 2000, 121 companies had planned to spend an equivalent amount; in 1997, the number was 279.

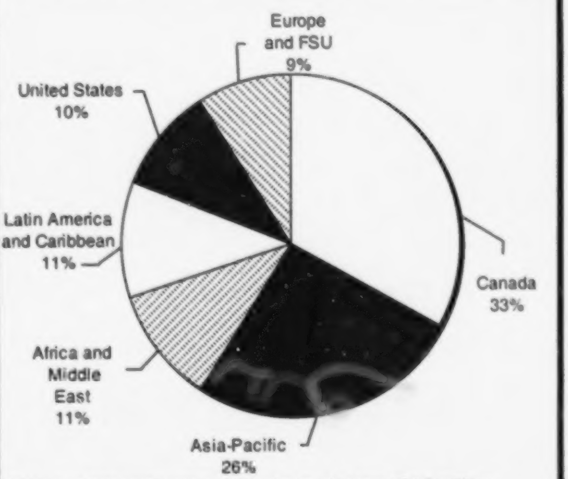
During 2001, the world's larger companies were expected to undertake exploration programs with a combined value of $2.5 billion (US$1.6 billion) in 99 countries, 7 countries fewer than in 2000.

The world's larger mining companies represent only about 15% of the 677 companies of all sizes that were expected to be active in mineral exploration worldwide in 2001. However, the larger companies account for over 80% of the value of all mineral exploration programs carried out around the globe. On a commodity basis, these companies account for almost 90% of the value of programs aimed at base metals and for 80% or more of those aimed at diamonds and gold. On a regional basis, they account for 90% of the programs planned for Latin America; 80% or more of those planned for Africa, Europe and the Former Soviet Union, and Asia-Pacific; and more than 70% of those planned for Canada.

LARGER CANADIAN-BASED COMPANIES

There are more mineral exploration companies based in Canada than in any other country (Figure 1). In spite of generally low prices for mineral commodities

Figure 1
Distribution of the World's Larger Exploration Companies, by Domicile, 2001



Based on 100 companies with budgets of at least $4.6 million (US$3 million) for precious-metal, base-metal or diamond exploration.

Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

in recent years and the difficulty for many companies who have no producing mines to raise capital, 32 Canadian-based companies each planned to spend $4.6 million or more on mineral exploration in 2001. In 2000, there were 48 Canadian-based companies that planned to spend an equivalent amount. In 1996, mining companies listed on Canadian stock exchanges raised a record amount of capital.[3] As a result, 141 Canadian-based companies had each planned to spend, in 1997, the equivalent of $4.6 million on exploration programs around the world. That year, their aggregate budgets for exploration, adjusted for inflation, reached an all-time high value of almost $2.1 billion.

In 2001, the total value of the exploration programs that the larger Canadian-based companies planned to undertake in both Canada and elsewhere around the world stood at $760 million (Figure 2), down by 16% from almost $910 million budgeted in 2000. About two-thirds of the decrease from 2000 to 2001 was expected to occur abroad.

The programs that the larger Canadian-based companies planned to undertake during 2001 represent 30% of all larger-company exploration programs for the entire world. Canadians account for the dominant share, by far, of all worldwide mineral exploration activity. Their closest rivals, the Australians, account for 20% while the Europeans account for 15%. In 1997, Canadian programs accounted for a record 35% of the value of all mineral exploration programs planned worldwide.

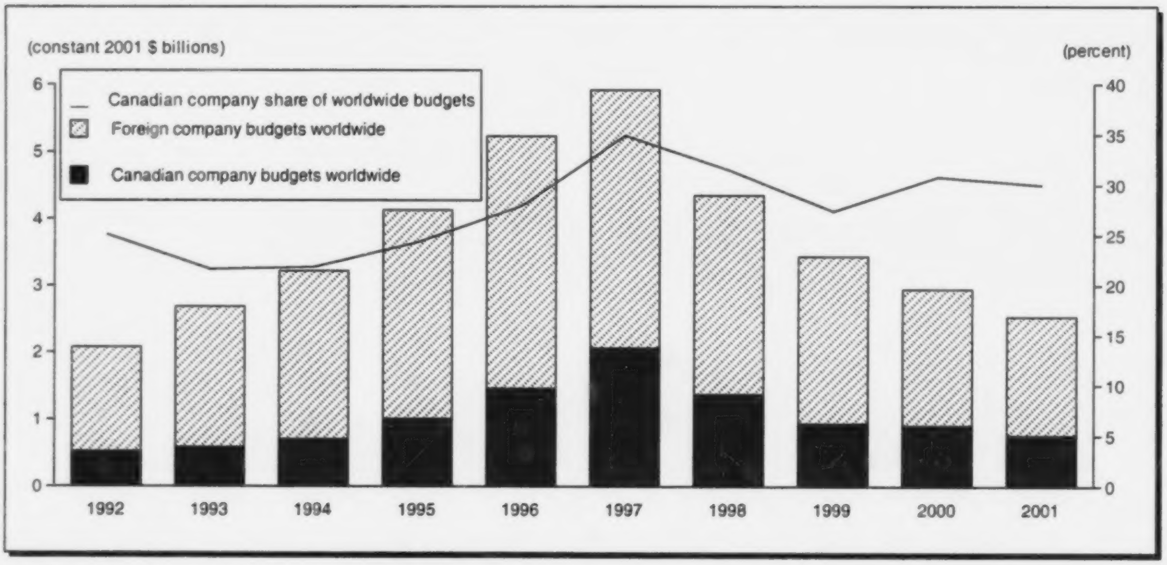
The larger Canadian-based companies typically budget less individually for exploration programs than the industry average worldwide. In 2001, the larger Canadian-based companies had exploration budgets with a mean of $23.7 million and a median of $8.3 million, compared with global averages of $25.8 million and $10.2 million, respectively. In 2001, the mean of the budgets prepared by the larger Canadian-based companies increased by more than $5 million compared with that of the budgets prepared the previous year. This reflects increasing concentration within the larger-company segment of the mining industry.

Although, on a company-by-company basis, there can be a significant variation between budgets and expenditures, aggregate exploration budgets generally provide a reliable estimate of the actual total amount spent in the field worldwide. In the case of the larger Canadian companies, actual expenditures in 1999 were about 7% lower than budgeted, roughly the same departure as observed in the previous year.[4]

Figure 2

Exploration Budgets of the World's Larger Companies, by Origin, 1992-2001

Companies with Worldwide Budgets of at Least $4.6 Million in 2001 for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than $4.6 million in 2001 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of almost 5700 mineral properties (Figure 3) located in Canada or in more than 100 other countries around the world.[5] Most of this portfolio is at the early stages of exploration. The number of properties held at the end of 2001 fell by about 600, or roughly 10%, compared with the number held at the end of the previous year. This reflects the difficulty, especially for the smaller companies, in continuing to obtain additional equity financing and the focus by most companies on core assets.

LARGER-COMPANY EXPLORATION MARKET IN CANADA

In 2001, the larger-company mineral exploration market in Canada was valued at $365 million, down by $45 million, or 12%, from roughly $410 million in 2000 (Figure 4). Only in Australia and the United States were aggregate exploration programs expected to experience a larger year-over-year reduction. Canada ranks second, after Australia, in terms of countries where the global mineral exploration industry is the most active. Canada has held that position since 1992. The smaller companies are an important part of the mineral exploration industry in Canada, but their activities are not addressed specifically here.

In 2001, 38 of the world's larger domestic-based or foreign-based companies planned to explore for minerals in Canada, down from 53 in 2000. Nonetheless, more than 14% of the exploration efforts of all of the world's larger companies were expected to take place in Canada in 2001 (Figure 5). This proportion is only somewhat larger than in 2000, but it is up from about 11% during each of the previous three years. Prior to the large increase in exploration activity that occurred in developing countries starting in the early 1990s, the proportion of all worldwide exploration activity taking place in Canada stood at 18%.

At the end of 2001, there were more than 3000 mineral properties with recent exploration activity in this country (Figure 3).[6]

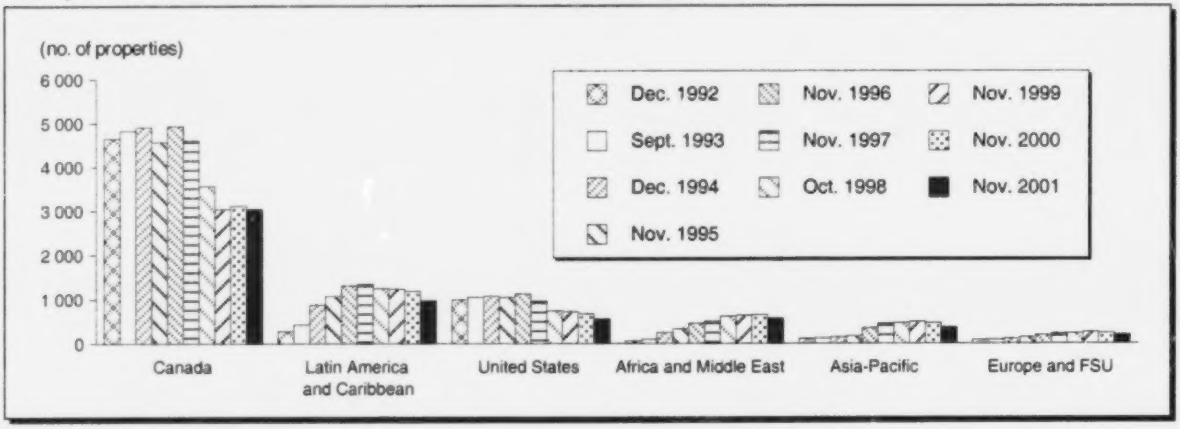
Larger Canadian-Based Companies in Canada

In 2001, 20 of the larger Canadian-based companies allocated, in total, $207 million for exploration in Canada. This amount is down by almost $60 million, or 25%, from the roughly $270 million allocated in 2000.

For the second year in a row, Canadian companies planned to spend more on mineral exploration in Canada than in all of Latin America. From 1995 to 1999, Canadian-based companies spent more in that region of the world than in this country.

The larger Canadian-based companies control 57% of the larger-company mineral exploration market in Canada. The dominance of exploration programs by

Figure 3
Canadian Mineral Property Portfolio Worldwide, by Region, 1992-2001
Companies of All Sizes Listed on Canadian Stock Exchanges

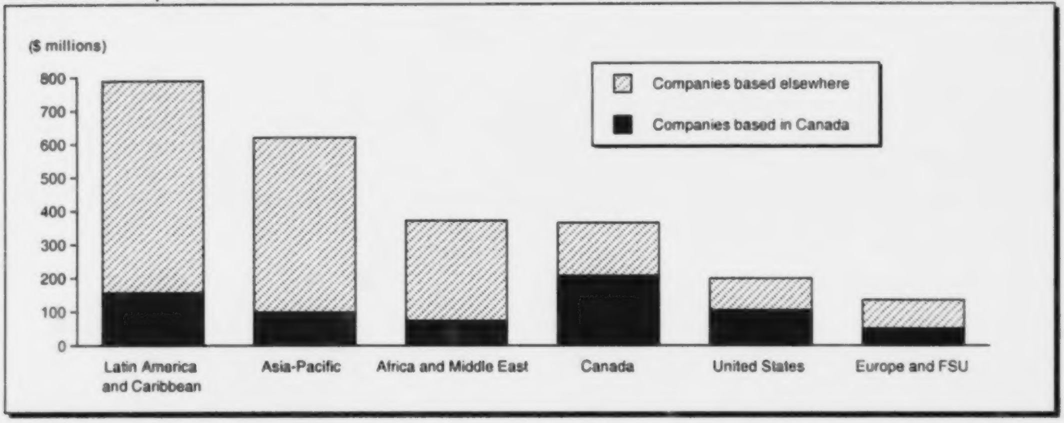


Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1992-1997 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.
Note: The decrease in properties in Canada after 1997 is due, in part, to the implementation of database features that make it possible to exclude many inactive properties.

Figure 4

Exploration Budgets of the World's Larger Companies for Selected Regions of the World, 2001

Companies with Worldwide Budgets of at Least $4.6 Million for Precious-Metal, Base-Metal or Diamond Exploration



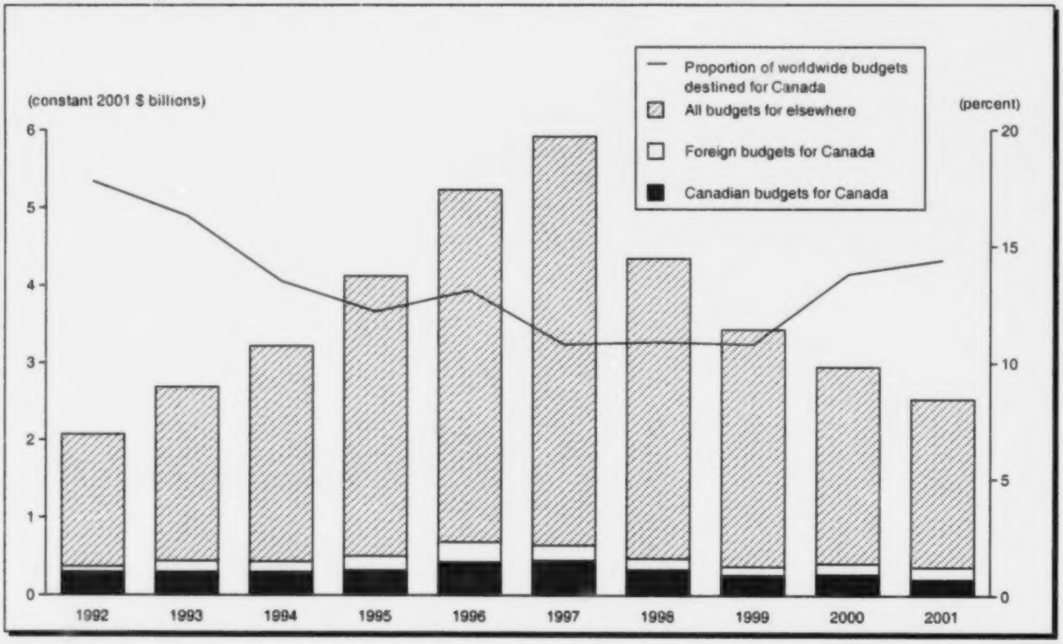
Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than $4.6 million in 2001 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

Figure 5

Exploration Budgets of the World's Larger Companies for Canada and Elsewhere, 1992-2001

Companies with Worldwide Budgets of at Least $4.6 Million in 2001 for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.

Notes: The worldwide exploration budgets of companies that intended to spend less than $4.6 million in 2001 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

domestic firms is relatively uncommon. In 2001, the only other countries where domestic companies controlled more than half of the larger-company market for mineral exploration were Sweden (56%), South Africa (66%), Australia (68%) and Japan (100%). That year, the market for mineral exploration was valued at over $400 million in Australia and over $65 million in South Africa, but was valued at less than $20 million in each of Japan and Sweden.

With increasing globalization, the share of the domestic exploration market controlled by Canadian-based companies has fallen gradually as foreign-based companies have increased the amount of exploration that they conduct in this country. In 1992, Canadian-based companies controlled 80% of the larger-company market in Canada but, by 2000, they controlled only two-thirds of it. Since the early 1990s, the share of the exploration market controlled by the larger domestic firms has also fallen gradually in the United States and Australia. Still, Canada remains the country where Canadian-based companies spend, by far, the largest proportion of their global mineral exploration budgets (Figure 6).

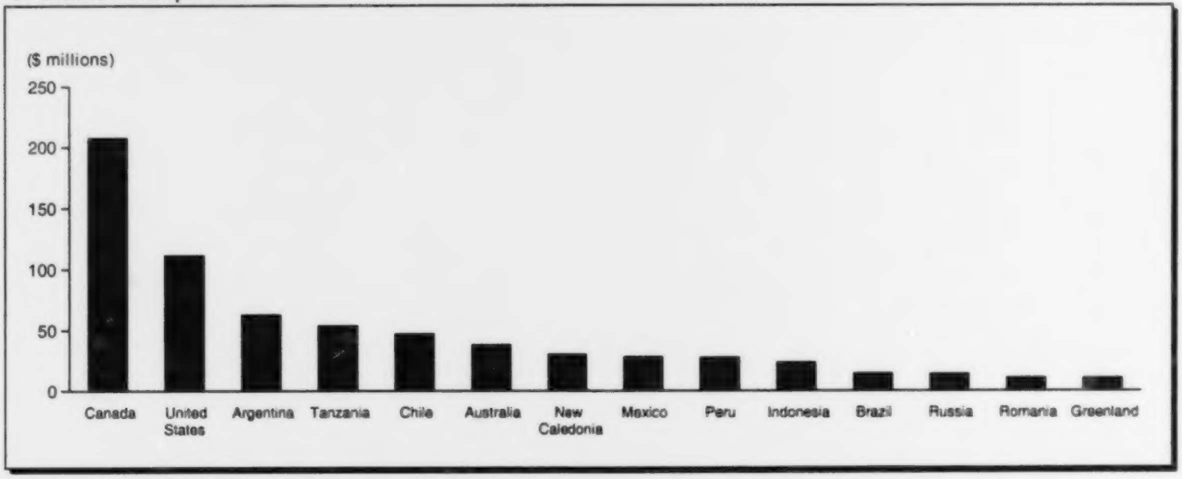
Foreign-Based Companies in Canada

During 2001, 17 of the larger foreign-based companies planned to spend, in total, almost $160 million on mineral exploration in Canada (Figure 5). This represents almost 45% of all activity planned for this country, up from one-third in 2000. Compared with the previous year, the budgets of foreign-based companies for Canada increased by more than $30 million.

In 2001, the larger foreign-based companies active in mineral exploration in Canada included: BHP Billiton Limited-BHP Billiton Plc,[7] Normandy Mining Ltd., Pasminco Limited, and WMC Limited, all based in Australia; Echo Bay Mines Ltd., Freeport-McMoRan Copper & Gold Inc., Newmont Mining Corporation, and Phelps Dodge Corporation, all based in the United States; Anglo American plc, Boliden Limited,[8] Outokumpu Oyj, and Rio Tinto plc, all based in Europe; Anglo American Platinum Corporation Limited, AngloGold Limited, the De Beers group, and Impala Platinum Holdings Limited (IMPLATS), all based in South Africa; and the Mexican mining consortium, Grupo Mexico S.A. de C.V.

In 2001, De Beers reported an exploration budget for Canada of almost $60 million. This budget is the largest reported for this country by all domestic and foreign companies operating here.

Figure 6
Exploration Budgets of the Larger Canadian-Based Companies, 2001
Countries Accounting for 90% of Canadian Budgets
Companies with Worldwide Budgets of at Least $4.6 Million for Precious-Metal, Base-Metal or Diamond Exploration



Source: Natural Resources Canada, based on *Corporate Exploration Strategies: A Worldwide Analysis*, Metals Economics Group, Halifax, Nova Scotia.
Notes: The worldwide exploration budgets of companies that intended to spend less than $4.6 million in 2001 (US$3 million) are excluded. The worldwide exploration budgets for other commodities such as uranium or industrial minerals are also excluded.

LARGER CANADIAN-BASED COMPANIES ABROAD

In 2001, the larger Canadian-based companies planned to spend over $550 million on mineral exploration outside of Canada (Figure 4). This amount is down by $70 million, or roughly 10%, from the more than $620 million these companies had planned to spend abroad in 2000.

More than 70% of the worldwide budgets of the larger Canadian-based companies for 2001 were allocated to programs abroad, the same proportion as in 2000. The foreign programs of the larger Canadian-based companies, as a proportion of their domestic and foreign programs combined, peaked at over 78% in 1997. In 1992, that proportion was only about 40%.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in a portfolio of more than 2600 mineral properties located abroad (Figure 3), down by roughly 500 properties from the previous year. Foreign properties represent slightly more than half of the total mineral property portfolio held by all companies listed in Canada, up from about 25% in 1992.

Apart from the United States, where companies of all sizes listed on Canadian stock exchanges have a substantial mining presence, about 30 other nations, spread across the globe, account for most of the balance of their mineral property portfolio held abroad (Figure 7).

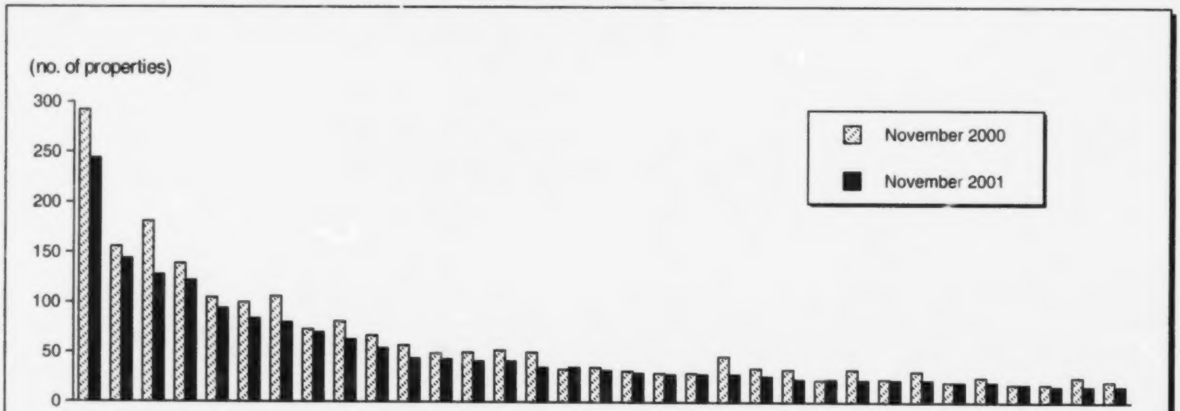
Canadian companies have interests in over 200 mines, smelters, refineries, plants under construction, or projects awaiting the results of a final production feasibility study in roughly 60 foreign countries.[9] They also have hundreds of other projects at the early stages of exploration in these countries and in more than 40 others. The activities of Canadian mining companies in Canada and abroad have fostered the development in this country of over 2200 suppliers of specialized mining goods and services, many of which export their products.[10]

United States

In 2001, the larger-company mineral exploration market in the United States was valued at almost $200 million (Figure 4), or about 8% of the $2.5 billion larger-company market worldwide. Larger-company budgets for the United States were down by $120 million compared with those of the previous year. This decrease represents the largest year-over-year reduction in budgets for a single country.

In spite of considerable global retrenchment, 14 of the larger Canadian-based companies planned to

Figure 7
Canadian Mineral Property Portfolio Abroad, 2000 and 2001 Countries Accounting for 80% of Canadian Holdings Located Outside the United States in 2001
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on InfoMine db, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

spend, in total, over $110 million in the United States, down from $160 million in 2000.

Companies based in most countries considerably reduced their exploration programs for the United States in recent years while those based in Canada increased theirs. As a result, the share of the larger-company exploration market held by Canadian-based companies in the United States has grown to over 55%. Canadian-based companies have increased their share of the exploration market in the United States almost every year since the early 1990s. The United States ranks second after Canada in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6).

During 2001, Canadian companies were expected to spend $60 million more than American companies in the United States. U.S. companies have budgeted decreasing amounts for mineral exploration in their country most years since the early 1990s. Although U.S. companies accounted for almost 60% of the value of all exploration programs in their country in 1992, their activities represented only 26% in 2001.

In late 2001, companies of all sizes listed on Canadian stock exchanges held about 550 mineral properties in the United States (Figure 3), down by roughly 20% from about 675 at the end of the previous year. In 2000, they had projects located in 22 states, but their efforts were concentrated mainly in the western part of the country in Nevada, Alaska, California, Arizona, Montana, Idaho, Wyoming, Colorado, Washington, Utah and South Dakota.[11] That year, Nevada alone accounted for more than 250 of their mineral properties, or almost 40% of the total Canadian portfolio in the United States.

Although Canadian companies have considerably expanded their activities in Latin America, Africa and Asia since the early 1990s (Figure 3), the United States is likely to remain, for the foreseeable future, the foreign country where they hold their largest portfolio of mineral properties. At the end of 2001, the United States accounted for over 20% of all properties held abroad by companies of all sizes listed on Canadian stock exchanges.

Of all the Canadian-based companies, Teck Cominco Limited,[12] Placer Dome Inc., Barrick Gold Corporation,[13] Formation Capital Corporation, and Kinross Gold Corporation planned the largest mineral exploration programs in the United States during 2001. Together these companies planned to spend over $95 million, equivalent to 85% of the value of all Canadian programs for that country.

In 2001, Teck Cominco planned to spend more than $30 million in the United States. The company's budget represents the largest program planned by domestic and foreign companies operating in that country. The company planned to spend much of its U.S. budget at the Pogo gold deposit and at the Red Dog zinc-lead-silver mine, both in Alaska, at the White Earth titanium deposit in Colorado, at the Pend Oreille zinc-lead deposit in the state of Washington, and at the Mesaba copper-nickel deposit in Minnesota.

Placer Dome planned to spend about two-thirds of its $25 million exploration budget for the United States in Nevada, much of it at the Cortez (South Pipeline) gold mine and at Getchell (Getchell, Turquoise Ridge and N Zone gold deposits).

Barrick planned to spend much of its almost $23 million budget for the United States on further exploration for gold at the Goldstrike operation (Betze-Post and Meikle mines, and Rodeo deposit), the Marigold mine, the Pinson mine, the Round Mountain mine, the Ruby Hill mine, the Rossi deposit, and the Dee property, all in Nevada.

Kinross planned to spend much of its $8 million U.S. budget in the vicinity of the Fort Knox open-pit gold mine in Alaska.

Latin America and the Caribbean

In 2001, the larger-company mineral exploration market in Latin America and the Caribbean was valued at $790 million (Figure 4), or over 30% of the $2.5 billion larger-company market worldwide. During 2001, the larger Canadian-based companies planned to spend over $190 million in the region, down by $30 million, or 14%, compared with 2000.

After Canada, Latin America is the region of the world where Canadian companies have become the most active in mineral exploration. However, from 1995 to 1999, Canadian companies spent more on mineral exploration in Latin America and the Caribbean than in Canada.

In 2001, Canadian companies held roughly one-quarter of the larger-company market in Latin America and the Caribbean. Canadian budgets stood a close second to those of companies based in the region. The share of the exploration market held by local companies increased to 32% in 2001, up from 29% the previous year; in 1994, local companies held less than 15% of the market in the region.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in about 975 mineral properties in Latin America and the Caribbean, down by roughly 20% from almost 1200 in 2000. Since 1996, the total number of mineral properties held by Canadian companies in the region has exceeded the number held in the United States (Figure 3).

Mexico

In 2001, the larger-company mineral exploration market in Mexico was valued at $106 million, or 4% of the $2.5 billion larger-company market worldwide. Larger-company budgets for Mexico were almost 20% lower than those of the previous year.

Mexico ranks third in Latin America, and eighth in the world, in terms of countries where Canadian companies are the most active in mineral exploration (Figure 6). Only two of the larger Canadian-based companies planned exploration programs in Mexico in 2001. These companies planned to spend, in total, about $30 million there. Nonetheless, the programs of these two companies represent over 20% of the market.

Teck Cominco planned to spend roughly 60% of its more than $20 million budget for Mexico at the San Nicholas copper-zinc-gold-silver deposit located in the state of Zacatecas. Towards the end of 2001, the company completed a feasibility study that estimated the capital cost of building a 15 000-t/d open-pit mine at San Nicholas at US$245.6 million. Reserves are estimated at 65 Mt grading 1.32% copper, 2.04% zinc, 0.53 g/t gold and 32.1 g/t silver. However, San Nicholas is unlikely to produce until prices for zinc and copper improve significantly. Teck Cominco's budget for Mexico was the second largest after that of the domestic company, Grupo Mexico. The latter company planned to spend almost $30 million on mineral exploration there.

At the end of 2001, companies listed on Canadian stock exchanges held interests in almost 250 properties in Mexico, down from about 300 in 2000.[11]

South America

In 2001, the larger-company mineral exploration market in South America was valued at more than $645 million, or over one-quarter of the $2.5 billion larger-company market worldwide. Since the early 1990s, over $5 billion (current U.S. dollars) has been spent by all of the world's mining companies on mineral exploration in South America.

In 2001, fourteen of the larger Canadian-based companies planned to spend, in total, over $155 million in the region. This represents roughly one-quarter of the mineral exploration market there. Canadian companies held the dominant share of the market in both Argentina and Chile.

As a result of the merger of California-based Homestake Mining Company with Toronto-based Barrick,[13] Argentina has become the country of South America where Canadian-based companies budget the most for mineral exploration (Figure 6). Argentina also ranks third in the world in terms of countries where Canadian companies are the most active in mineral exploration.

In 2001, Barrick planned to spend almost $58 million in Argentina. The company's program accounted for more than half of all programs planned for that country. Barrick planned to allocate most of that budget to drill the Veladero gold-silver deposit and the Lama portion of the Pascua-Lama gold-silver deposit, which straddles the Chile-Argentina border. Barrick recently announced that it is planning to develop Pascua-Lama and Veladero as a single operation.

In Chile, Barrick planned to spend much of its $18 million budget for that country on the Pascua portion of the Pascua-Lama deposit. The company also planned to spend about $2 million at the Agua de la Falda gold mine. Barrick's mineral exploration budget for Chile was the second-largest for the country. The domestic company, Corporación Nacional del Cobre de Chile (CODELCO), planned to spend about twice as much.

In Peru, Barrick planned to spend roughly $11 million on grass-roots exploration on the Pierina gold belt and at other locations in the country.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held over 600 mineral properties throughout South America, down from more than 750 at the end of the previous year. They held about 140 properties in Argentina, almost 130 in Peru, more than 75 in each of Brazil and Chile, and over 25 in each of Bolivia, Guyana and Ecuador (Figure 8).

Central America

In 2001, the larger-company mineral exploration market in Central America was valued at over $9 million, or less than 1% of the $2.5 billion larger-company market worldwide.

Vancouver-based Radius Explorations Ltd. is the only larger Canadian-based company that reported an exploration program for the region. The company planned to spend $5 million drilling the El Tambor gold prospect in Guatemala.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held about 90 mineral properties throughout Central America. They held 15 or more in each of Honduras, Guatemala and Panama (Figure 9).

Caribbean

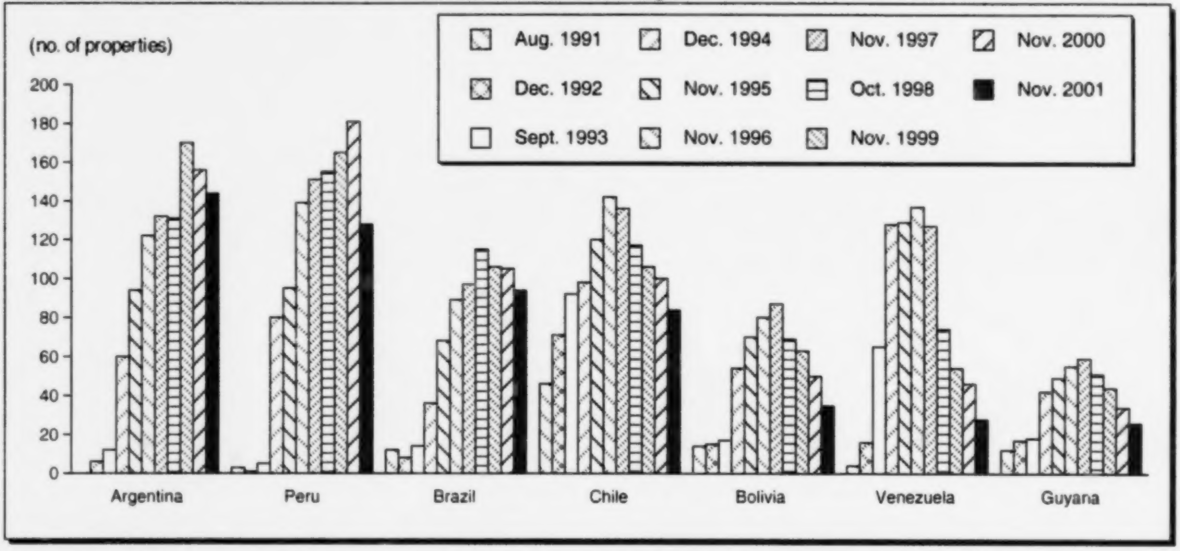
In 2001, the larger-company mineral exploration market in the Caribbean was valued at about $0.3 million, or less than 1% of the $2.5 billion larger-company market worldwide.

Figure 8

Canadian Mineral Property Portfolio in South America, 1991-2001

Countries Accounting for 90% of Canadian Holdings in 2001

Companies of all Sizes Listed on Canadian Stock Exchanges

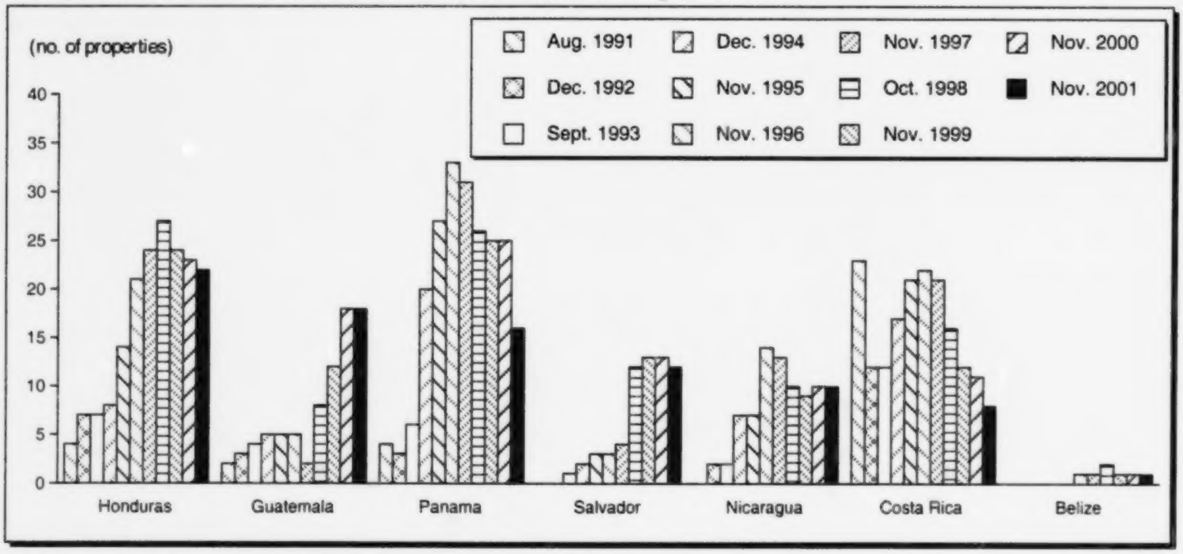


Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 9

Canadian Mineral Property Portfolio in Central America, 1991-2001

Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Northern Orion Explorations Ltd. (majority owned by Miramar Mining Corporation) is the only larger Canadian-based company that reported an exploration program for the Caribbean. The company has a 50% interest in the Mantua copper-gold deposit, which is located in Cuba. The deposit contains a resource of 7.5 Mt grading 2.74% copper.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held about 40 mineral properties in the Caribbean, most of them in the Dominican Republic and Cuba.

Europe and the Former Soviet Union

In 2001, the larger-company mineral exploration market in Europe and the Former Soviet Union (FSU) was valued at $135 million (Figure 4), or slightly more than 5% of the $2.5 billion larger-company market worldwide. The larger Canadianbased companies planned to spend almost $50 million in the region, equivalent to roughly 40% of the market.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held almost 200 mineral properties in Europe and the FSU (Figure 3).

Western Europe

In 2001, the larger-company mineral exploration market in western Europe was valued at almost $65 million, or slightly more than 2% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend almost $15 million there, equivalent to more than 20% of the market. Canadians held the dominant share of the market in Greenland and Norway.

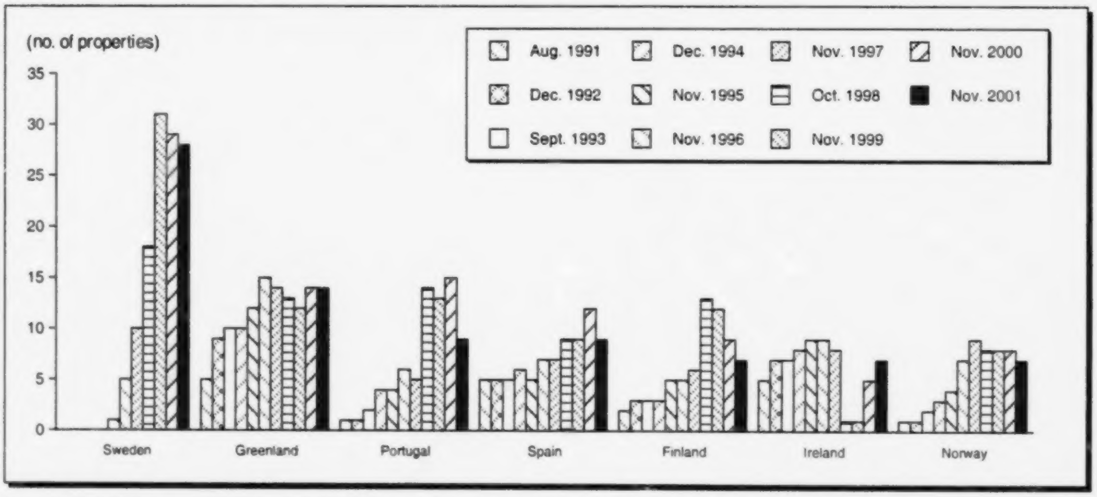
In Greenland, Crew Development Corporation planned to spend almost $10 million on advanced exploration at the Nalunaq high-grade narrow-vein gold deposit, the largest program in that country. Measured and indicated resources at Nalunaq are estimated at 360 000 t grading 25 g/t gold. A prefeasibility study completed in early 1999 estimated the cost of a 500-t/d underground mine producing 148 000 oz of gold annually at US$20 million. The results of a bankable feasibility study were expected to be released in mid-2002.

In Norway, Crew planned to spend roughly $0.5 million at the Røros zinc-copper complex. Falconbridge Limited planned to spend about $0.3 million evaluating new prospects.

In Finland, CMQ Resources Inc. planned to spend $0.8 million on grass-roots exploration for platinum group metals at the Kuusamo property. Noranda Inc. planned to spend $1.8 million exploring for lead and zinc deposits.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held almost 90 mineral properties in western Europe. They held roughly 30 in Sweden, more than 15 in Greenland, and 10 in each of Portugal and Spain (Figure 10).

Figure 10
Canadian Mineral Property Portfolio in Western Europe, 1991-2001
Countries Accounting for 90% of Canadian Holdings in 2001
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Eastern Europe

In 2001, the larger-company mineral exploration market in eastern Europe was valued at over $28 million, or about 1% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $20 million in eastern Europe, equivalent to almost 70% of the market. Canadian-based companies held the dominant share of the market in Romania and Turkey.

In Romania, Gabriel Resources Limited planned to spend over $4 million, about 80% of it to continue to assess the feasibility of bringing the Rosia Montana gold-silver deposit into production. In 2001, the capital cost of building a 13-Mt/y conventional open-pit mine at Rosia Montana was estimated at US$258 million. The deposit contains proven and probable reserves estimated at over 200 Mt grading 1.56 g/t gold and 7.8 g/t silver. The mine is expected to produce for over 16 years. The company planned to proceed with basic engineering and permitting for the project. Production could begin by 2005. Also in Romania, European Goldfields Ltd. planned to spend $6 million, more than half of it on the Certej gold-silver deposit.

In Turkey, Eldorado Gold Corporation planned to spend roughly $5 million on advanced exploration for gold, mainly at the Kisladag and Efemçukuru deposits. At Kisladag, a revised pre-feasibility study prepared during 2001 estimated the cost of building a 3.4-Mt/y heap-leach open-pit mine at $30 million. The initial plant would be expanded at a later date.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held almost 60 mineral properties in eastern Europe. They held almost 30 in Turkey and over 10 in Slovakia (Figure 11).

Former Soviet Union

In 2001, the larger-company mineral exploration market in the countries of the FSU was valued at almost $37 million,[14] or more than 1% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend about $15 million in these countries, about twice as much as in 2000.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in about 50 mineral properties in five countries of the FSU (Figure 12), down from almost 70 at the end of the previous year.

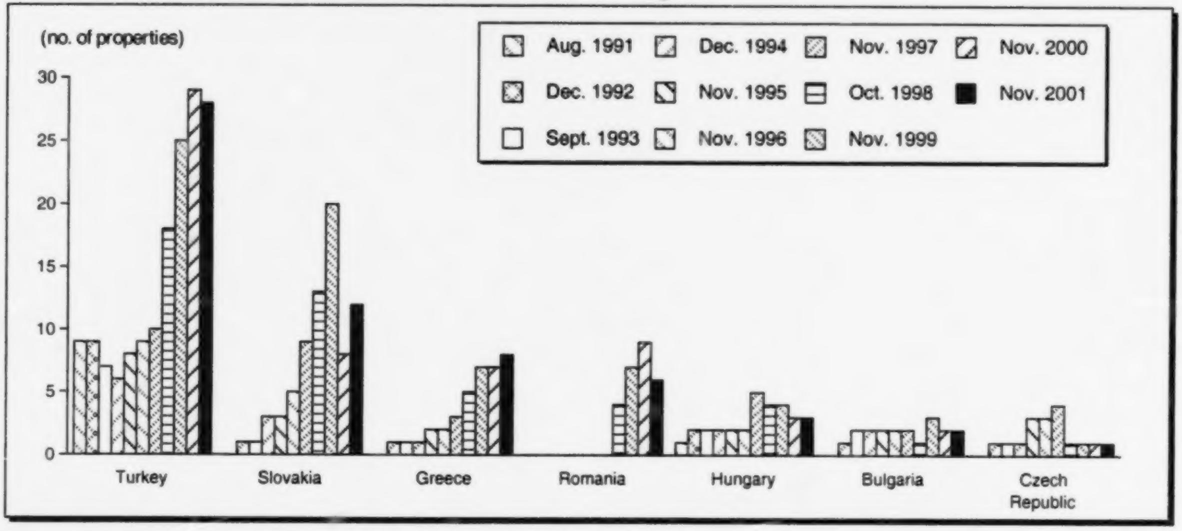
Although Canadian-based companies planned to carry out regional exploration programs in the FSU, Russia is where they planned to undertake most of their exploration programs in 2001. They expected to spend roughly $14 million on exploration in that country, equivalent to over 60% of the market.

Figure 11

Canadian Mineral Property Portfolio in Eastern Europe, 1991-2001

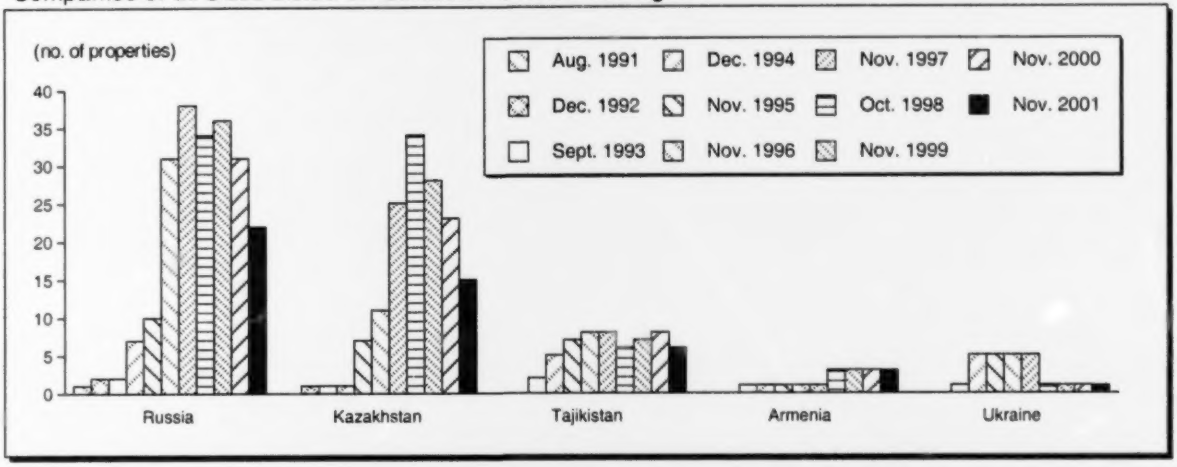
Countries With Canadian Holdings in 2001

Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Figure 12
Canadian Mineral Property Portfolio in the Former Soviet Union, 1991-2001
Countries with Canadian Holdings in 2001
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

In Russia, Kinross planned to spend over $5 million at the Birkachan gold prospect and at other sites, all within a 50-km radius of the Kubaka open-pit gold-silver mine.

Placer Dome planned to spend $1.4 million at the Nevyansk gold deposit located in the Urals and at other properties in the country. Falconbridge planned to spend $1.5 million on mapping and geophysics at the Khabarovskkrai nickel-copper property and elsewhere in the Russian Far East.

The number of properties held in Russia by companies of all sizes listed on Canadian stock exchanges stands at over 20.

Africa and the Middle East

In 2001, the larger-company mineral exploration market in Africa and the Middle East was valued at more than $370 million (Figure 4), or almost 15% of the $2.5 billion larger-company market worldwide. That region of the world is one of the few that did not experience a significant decrease, both in absolute terms and in percentage terms, in exploration activity from 2000 to 2001.

Africa

In 2001, the larger-company mineral exploration market in Africa was valued at over $360 million (Figure 4), or more than 14% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend more than $70 million there, equivalent to almost 20% of the market on that continent.

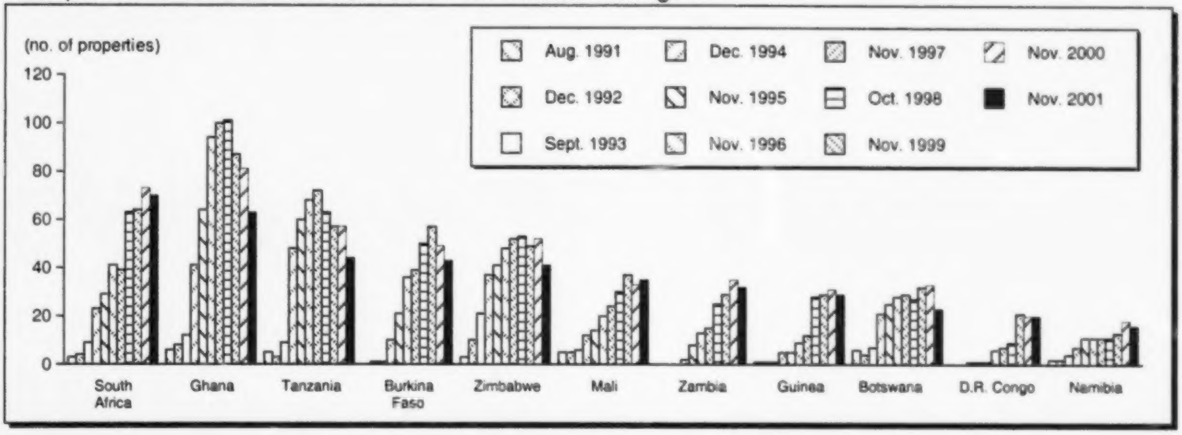
In 2001, Canadian mineral exploration budgets for Africa increased by $10 million compared with those of the previous year. The larger Canadian-based companies were expected to finance the largest share of the mineral exploration programs planned for Senegal and Tanzania.

In Senegal, IAMGOLD Corporation planned to spend over $1.8 million on grass-roots exploration for gold at the Bambadji property.

Barrick planned to spend more than $45 million looking for gold in Tanzania. The company planned to spend more than $25 million of that amount to increase reserves at the Bulyanhulu underground mine where production started in April 2001. It also planned to spend almost $17 million on the Tulawaka property where a resource of 1 million oz of gold has been identified. Barrick's budget for Tanzania represents one of the largest company exploration programs for a single country.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in over 550 mineral properties in 39 countries on the African continent. This represents a decrease of about 100 properties since the end of 2000. At the end of 2001, Canadian companies held interests in 50 or more properties in each of South Africa and Ghana (Figure 13).

Figure 13
Canadian Mineral Property Portfolio in Africa, 1991-2001
Countries Accounting for 75% of Holdings in 2001
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

Middle East

In 2001, the larger-company mineral exploration market in the Middle East was valued at $9 million. The larger Canadian-based companies planned to spend $0.2 million there, equivalent to less than 2% of the market in that region.

Asia-Pacific

In 2001, the larger-company mineral exploration market in Asia-Pacific was valued at $620 million (Figure 4), or almost one quarter of the $2.5 billion larger-company market worldwide.

Exploration budgets for the region were $140 million less than those proposed in 2000. Activity was expected to be down by over $70 million in Australia, which represents the second largest year-over-year decline for a single country after the one that was expected to occur in the United States. Exploration activity was also expected to be down by $40 million in Papua New Guinea and down by $25 million in Indonesia.

The larger Canadian-based companies planned to spend $114 million in the region, equivalent to over 18% of the market. Their budgets for Asia-Pacific in 2001 were maintained at the same level as in 2000.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held interests in over 350 mineral properties in Asia-Pacific (Figure 3), down by over 20% from about 460 at the end of the previous year.

Southeast Asia

In 2001, the larger-company mineral exploration market in Southeast Asia was valued at almost $135 million, or slightly more than 5% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend $37 million in the region, equivalent to more than one-quarter of the market there.

In Indonesia, Weda Bay Minerals Inc. planned to spend over $20 million to continue to assess the feasibility of bringing the Halmahera Island lateritic nickel-cobalt deposit into production. In June 2001, the company completed a pre-feasibility study for a pressure acid-leach plant that would produce 48 500 t/y of nickel and 4600 t/y of cobalt. The company is examining alternatives for processing the resource, which is estimated at over 200 Mt grading 1.37% nickel and 0.11% cobalt.

In Papua New Guinea, Placer Dome planned to spend $4 million to increase reserves at the Porgera open-pit gold mine. That operation produced over 761 000 oz of gold in 2001.

In the Philippines, Crew planned to spend more than $4 million on advanced exploration at the Mindoro lateritic nickel-cobalt deposit. In 1998, the company completed a pre-feasibility study for an open-pit mine there that would produce 40 000 t/y of nickel and 3000 t/y of cobalt over a 30-year period. Resources at Mindoro are estimated at over 200 Mt grading 0.92% nickel and 0.08% cobalt.

In Myanmar, Ivanhoe Mines Ltd. planned to spend $1.5 million looking for gold at the Modi Tuang property.

In Vietnam, Falconbridge planned to spend $1 million at the Ban Phuc nickel-copper deposit. Ban Phuc contains an indicated resource estimated at 2.6 Mt grading 1.85% nickel, 0.6% copper and 0.056% cobalt.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held over 150 mineral properties in Southeast Asia, down from over 200 at the end of the previous year. They held about 80 properties in Indonesia and more than 40 in the Philippines (Figure 14).

East Asia

In 2001, the larger-company mineral exploration market in east Asia, which includes China, Japan, Mongolia and South Korea, was valued at $33 million,[14] or slightly more than 1% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies planned to spend over $9 million in the region, equivalent to roughly 30% of the market.

Since the early 1990s, there has been considerable Canadian interest in the mineral potential of China. In 2001, Placer Dome, Teck Cominco, Falconbridge and Noranda planned exploration programs in China. Placer Dome planned to spend $1.4 million on grass-roots exploration for gold in that country. In late 2001, companies of all sizes listed on Canadian stock exchanges held interests in about 50 mineral properties in China (Figure 14).

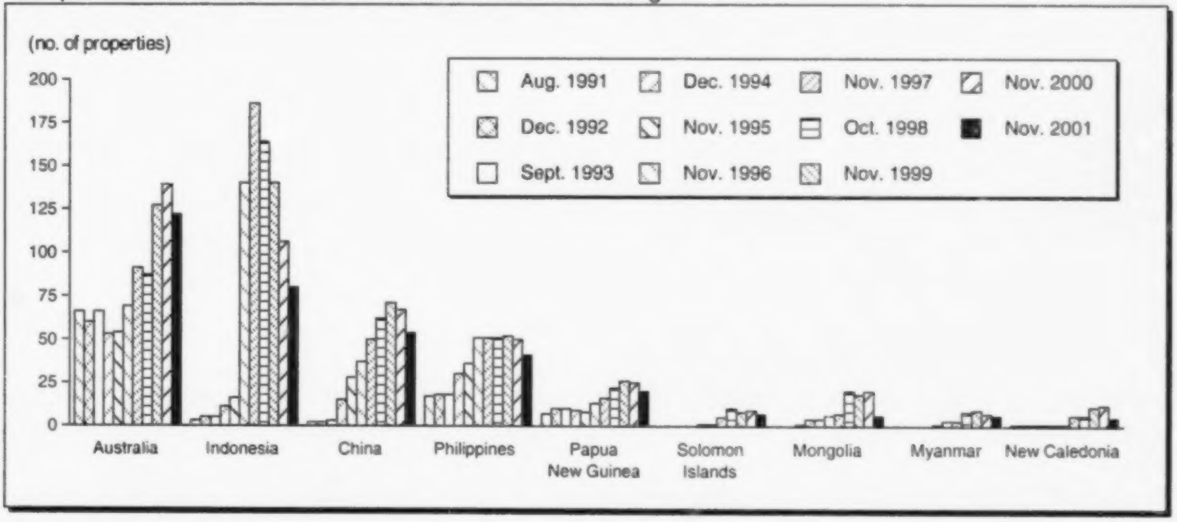
In South Korea, Ivanhoe planned to spend about $3 million on exploration for gold. In Mongolia, the company planned to spend $1.5 million on grass-roots exploration for gold and base metals at the Oyu Tolgoi (Turquoise Hill) property; Cameco Corporation planned to spend over $2 million on exploration for gold in the country.

South Pacific

In 2001, the larger-company mineral exploration market in the South Pacific was valued at over $440 million, or more than 17% of the $2.5 billion larger-company market worldwide. Australia accounted for over 90% of that market. The larger Canadian-based companies planned to spend almost $68 million in the region.

In New Caledonia, Falconbridge planned to spend over $30 million for advanced exploration at the Koniambo lateritic nickel deposit. Inferred resources at Koniambo are estimated at 151 Mt grading 2.58% nickel. A pre-feasibility study for a 60 000-t/y ferronickel plant is currently under way. Falcon-

Figure 14
Canadian Mineral Property Portfolio in Asia-Pacific, 1991-2001
Countries Accounting for 95% of Canadian Holdings in 2001
Companies of all Sizes Listed on Canadian Stock Exchanges



Source: Natural Resources Canada, based on *MIN-MET CANADA* for 1991-97 and InfoMine db for 1998-2001, Robertson Info-Data Inc., Vancouver, British Columbia, and used under licence.

bridge's budget for Koniambo in 2001 is among the largest for a single Canadian project abroad. The deposit could be in production by 2003.

In early 2001, Inco Limited announced that it planned to build, at Goro, also in New Caledonia, a US$1.4 billion open-pit mine and processing plant that would use hydro-metallurgical and solvent extraction processes. The operation would have a capacity of 54 000 t/y of nickel and 5400 t/y of cobalt. Production is planned for 2004.

Barrick planned to spend $16 million on mineral exploration in Australia. The company planned to spend about 70% of its budget for that country to increase reserves at the Plutonic, Darlot-Centenary and Lawlers gold mines. It planned to spend the rest of its budget on grass-roots exploration for gold on the Plutonic Well greenstone belt, at Warrida Well, and elsewhere in the country. Placer Dome planned to spend almost 80% of its more than $9 million budget for Australia to increase reserves at the Granny Smith and the Kidston gold mines, and at the Osborne copper mine. Noranda planned to spend almost half of its more than $6 million budget for Australia at the Lady Loretta zinc-lead-silver deposit. Reserves at Lady Loretta are estimated at 11.5 Mt grading 15.2% zinc, 5.4% lead and 90 g/t silver.

At the end of 2001, companies of all sizes listed on Canadian stock exchanges held almost 140 properties in the South Pacific, of which over 90% are located in Australia (Figure 14).

South Asia

In 2001, the larger-company mineral exploration market in South Asia, which includes India, Pakistan and Sri Lanka, was valued at about $10 million, or less than 1% of the $2.5 billion larger-company market worldwide. The larger Canadian-based companies reported no exploration programs for that region of the world.

SUMMARY AND OUTLOOK

In 2001, the larger Canadian-based companies planned to conduct, in Canada and elsewhere around the world, mineral exploration programs valued at almost $760 million. Canadians were expected to undertake 30% of the $2.5 billion in exploration programs planned by all of the world's larger companies. The share of the global mineral exploration market controlled by Canadian companies is the largest, by far.

More than 14% of the world's larger-company mineral exploration activity was expected to occur in Canada in 2001, the same proportion as in 2000. Canada ranks second in terms of countries where the world's mineral exploration companies are the most active.

During 2001, and for the second year in a row, Canadians planned to conduct more mineral exploration in Canada than in all of Latin America. Canadian companies planned to conduct the largest share of exploration programs, not only in Canada, but also in the United States, the Caribbean, eastern Europe, and Southeast Asia. Although Canadian companies have diversified their portfolio of mining assets to well over 100 countries, Canada remains the country where they continue to be, by far, the most active.

Mineral commodity prices remain relatively low and this affects the amount of revenue that can be reinvested in mineral exploration. Financing exploration projects for many of the smaller companies continues to be difficult. As a result, many of these smaller companies are inactive. Canadian companies are focussing their efforts on their most promising assets. This is reflected in a 10% decrease in the number of mineral properties held in Canada and abroad from more than 6300 at the end of 2000 to less than 5700 at the end of 2001.

The larger-company exploration market is becoming increasingly concentrated. The number of companies spending the equivalent of US$3 million per year on exploration (C$4.6 million in 2001) has decreased significantly since the late 1990s. In the case of Canadian companies, the number has fallen from an all-time high of 141 in 1997 when financing was readily available to only 32 in 2001.

Globalization of the mining industry is continuing. In Canada, the share of the mineral exploration market controlled by foreign companies has increased from 20% in 1992 to over 40% in 2001. Mergers and acquisitions have become a frequent occurrence in the mining industry. The merger of California-based Homestake with Toronto-based Barrick in late December 2001 propelled Barrick to the rank of second-largest gold producer in the world. Not only did Homestake contribute a significant number of mineral properties to Barrick's portfolio of exploration and producing assets, it also increased Barrick's total Canadian exploration budget worldwide to over $180 million. As a result, Barrick became the company with the largest mineral exploration budget in the world.

Although Canadian companies tend, on average, to have smaller exploration budgets than their competitors, they are considerably more numerous than companies based elsewhere. As a result, Canadians are likely to continue, for the near future at least, to dominate mineral exploration worldwide.

REFERENCES

[1] All currencies in this review are expressed in Canadian dollars unless otherwise indicated.

[2] Most of the data on the larger-company mineral exploration market worldwide are based on *Corporate Exploration Strategies: A Worldwide Analysis*, published annually by Metals Economics Group, Halifax, Nova Scotia (tel. [902] 429-2880).

[3] Keith Brewer and André Lemieux, *Canada's Global Position in Mining - Canadian Financing of the International Mining Industry*, Metals Finance 4th International Conference, Toronto, May 7-9, 1997, Natural Resources Canada, Ottawa, 53 pp. (tel. [613] 995-4577).

[4] For more information on various aspects of the relationship between exploration budgets and exploration expenditures for the larger Canadian-based companies, see André Lemieux, "Canada's Global Mining Presence," in the 1998 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.1 and 7.2 (www.nrcan.gc.ca/mms/cmy/content/1998/08.pdf). See also André Lemieux, "Canada's Global Mining Presence," in the 1999 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada Ottawa, pp. 7.1 and 7.3 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[5] Most of the data for 1991 through 1997 on the mineral property portfolio of companies of all sizes listed on Canadian stock exchanges are derived from MIN-MET CANADA; for 1998 through 2001, they are derived from InfoMine db. These databases are products of Robertson Info-Data Inc. of Vancouver, British Columbia (tel. [604] 683-2037).

[6] For trends in mineral deposit appraisal activity in Canada over the interval 1982-97, and for a list of projects at the deposit appraisal stage in the late 1990s, see André Lemieux, "Canada's Global Mining Presence," in the 1996 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 8.9 and 8.11-8.22 (www.nrcan.gc.ca/mms/cmy/content/1996/08.pdf).

[7] BHP Billiton was formed from the merger, in June 2001, of BHP Limited and Billiton Plc. The company is listed on the London Stock Exchange as BHP Billiton Plc; it is also listed on the Australian Stock Exchange as BHP Billiton Limited. The corporate headquarters of BHP Billiton are located in Melbourne, Australia.

[8] In November 2001, Boliden Limited changed its domicile from Toronto to Stockholm, Sweden. Boliden remains listed on the Toronto Stock Exchange.

[9] For a list of mines, smelters, refineries and other advanced mineral development projects in which companies based in Canada had an interest in mid-2001, see André Lemieux, "Canada's Global Mining Presence," in the 2000 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.16-7.19 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[10] For a discussion of the global market for mining goods and services and the role played by Canadian companies, see André Lemieux, *Canadian Suppliers of Mining Goods and Services: Links Between Canadian Mining Companies and Selected Sectors of the Canadian Economy*, Natural Resources Canada, Ottawa, September 2000, 84 pp. (www.nrcan.gc.ca/mms/pubs/services- mines-e.pdf).

[11] For a geographic distribution of mineral properties in which Canadian companies have an interest in the United States and in Mexico, see André Lemieux, "Canada's Global Mining Presence," in the 2000 edition of the *Canadian Minerals Yearbook*, Natural Resources Canada, Ottawa, pp. 7.5 and 7.7 (www.nrcan.gc.ca/mms/cmy/content/08.pdf).

[12] Vancouver-based Teck Corporation and Cominco Ltd. merged effective July 20, 2001. The name of the company was changed, in September 2001, to Teck Cominco Limited. The exploration budget of Teck Cominco discussed in this review refers to the combined budgets of the merged companies.

[13] California-based Homestake Mining Company merged with Toronto-based Barrick Gold Corporation on December 14, 2001. As a result, Barrick Gold Corporation, the successor company, became the second-largest gold producer in the world. The exploration budget of Barrick discussed in this review refers to the combined budgets of the merged companies.

[14] The size of the mineral exploration market in certain regions of the world is probably underestimated because there are few data available on the extent of exploration programs undertaken by some state agencies.

Notes: (1) Information in this review was current as at July 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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Canada's Historical Mineral Production

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HISTORICAL BACKGROUND

Minerals have been used in what is now Canada for several millenia. Canada's Aboriginal inhabitants used various minerals to produce tools, weapons and decorative objects, including pebbles and cobbles for tools and weapons, and clay, flint, chert, pipestone, soapstone (for lamps, pots and carving), native copper, gold and silver. Some of these mineral commodities were traded among the Aboriginal peoples over distances of hundreds or even thousands of kilometres.

The early European settlers in Canada produced a limited number of mineral commodities for local use, chiefly building stone, brick clay, sand, gravel, and lime for plaster. Coal was discovered on Cape Breton Island by the French in 1672. The British Navy first obtained coal there in 1711. In New Brunswick, coal was first mined by settlers in 1782. Coal was discovered in what is now Alberta in 1800 and, on Vancouver Island, coal deposits were discovered in 1835 and 1850.

Iron ore was found along the St. Lawrence River near the mouth of the Saint-Maurice River and smelted there to produce iron beginning in 1737. After the American Revolution, iron furnaces utilizing local ores were erected in what is now southern Ontario in 1800, 1820 and 1822. The earliest recorded Canadian production of gypsum was in Nova Scotia in 1789 and in Ontario in 1822.

Initial Canadian nonferrous metal production, of copper, began in 1848 at Bruce Mines, Ontario. The first production of gold was in the late 1850s from the small Early Bird mine on the Queen Charlotte Islands. Placer gold was discovered and initially produced in 1859 in the Cariboo Region of British Columbia. Some placer gold was produced from the Chaudiere River in the Eastern Townships of Quebec beginning in 1862. Gold was discovered in Nova Scotia in 1860 and over the years, beginning in 1861, some 45 t of gold have been produced in the province.

Petroleum, found in 1857 at Oil Springs, Ontario, near Lake Erie, represented North America's earliest commercial petroleum discovery – a discovery that was made the same year the European oil industry began in Romania and two years prior to the first commercial discovery in the United States at Oil Creek, near Titusville, Pennsylvania.

Cariboo gold, Ontario petroleum and increased output of Cape Breton coal marked a turning point in Canadian mineral production from minor local events to developments of greater significance.

PRODUCTION STATISTICS

Statistical data concerning Canadian mineral production began to be gathered and compiled in the 1850s. The Geological and Natural History Survey of Canada began collecting and publishing mineral production statistics in 1886. The Department of Mines, which the Geological Survey became a part of, carried out this work through the early part of the 20th century. The work was then transferred to the Dominion Bureau of Statistics (now Statistics Canada), which compiled mineral production data from 1921 until 1978. In January 1979, the responsibility for gathering non-fuel, non-manufactured, mineral production statistics was transferred from Statistics Canada to the Department of Energy, Mines and Resources, which has since become the Department of Natural Resources (or Natural Resources Canada). Statistics Canada retains the responsibility for gathering statistics concerning fuel, crude oil, natural gas, natural gas liquids and coal production, and for gathering mineral manufacturing statistics, including cement, lime and clay products.

A historical compilation of production statistics for minerals, up to and including those for 1946, was published by Statistics Canada (then the Dominion Bureau of Statistics) in 1948, and then annual production statistics were published for subsequent years. Newfoundland did not join Canada until 1949; therefore, the mineral production statistics published by Statistics Canada prior to that year do not include Newfoundland mineral production. For most mineral commodities, available production statistics begin with those for the year 1886, but there was Canadian production of many mineral commodities in years prior to that year, and production statistics are available for some of those commodities beginning with the following years: gold, 1858; coal, 1867; phosphate, 1870; gypsum, 1874; iron ore, 1876; manganese ore and bog manganese, 1877; arsenic, 1885; barite, 1885; and pyrite, 1885.

HISTORICAL PRODUCTION GRAPHS

Historical production statistics for the mineral commodities that have been produced in Canada are displayed in graphical form (Figures 1 to 75). Although it has not been possible to obtain mineral production statistics for Newfoundland and Labrador for the years prior to 1949, statistics concerning mineral exports were obtained from Newfoundland customs export records. The first recorded mineral exports of copper, lead and limestone begin with 1865. For some of the commodities that were exported (building stone, coal, stone, gypsum, limestone, and sand and gravel), all of them mineral commodities that would have been consumed in the province as well as having been exported, the tonnages exported do not provide a source of production statistics. However, it can be assumed that the total production of ores and concentrates of other mineral commodities (copper, nickel, lead, zinc, chromite, gold, iron ore, silver, barite, talc and fluorite, and probably pyrite) were not further processed in Newfoundland and Labrador, but entirely exported. The exported tonnages can be taken as a proxy for production tonnages, so they have been added to the tonnages of each of the commodities produced in the rest of Canada to obtain total Canadian production of those commodities – these totals have been used to prepare the production graphs for those 12 commodities.

Many of the mineral commodities that were produced in Canada in earlier years are no longer produced, (e.g., corundum, feldspar, fluorspar [fluorite], garnet, grindstones, helium, magnesium sulphate, natroalunite, peat fuel, pulpstones and sharpening stones). The production of some of these mineral commodities has ceased because known reserves have been mined out. The production of others (e.g., natural grindstones, pulpstones and sharpening stones) has ceased because they have become obsolete. The production of some commodities has been intermittent over the years; others were produced for only very brief periods of time.

The annual production tonnages reported by Statistics Canada actually represent tonnages shipped during the year rather than production tonnages. Therefore, some production peaks, for example the 15 t of platinum group metals reported for 1942 and the 21 t reported for 1945 (see Figure 22), likely represent delayed shipment from an inventory of metal actually produced in earlier years.

Although various mineral commodities were produced in Canada long before 1886, the only minerals for which any pre-1886 production statistics are available are arsenic, barite, coal, copper, gold, gypsum, iron ore, manganese ore, phosphate, pyrite and silver. The production graphs for these commodities portray production back to the first year for which production data are available. The titles of each of Figures 1 to 72 indicate the first year for which production data are available and, in the case of mineral commodities no longer produced in Canada, the final year of production. For some minerals, it is not certain whether or not the first year indicated actually represents the year of initial Canadian production. For minerals that the graphs indicate as having commenced production subsequent to 1886, the first year indicated in the title likely does represent the year of initial production.

It is evident that all, or nearly all, of the mineral commodities for which production statistics begin with 1886 were actually being produced in Canada prior to 1886.

Tonnages of clay products produced in Canada have never been compiled; only annual production values have been compiled for 1886 to 2000 in dollars of the year. For purposes of comparison, these annual values have been converted to 2001 Canadian dollars and plotted in Figure 66.

In the case of mineral water, production tonnages were not published for the years 1899 to 1920 inclusive, but values were published. For this reason, both tonnages of mineral water (Figure 47) and value in 2001 dollars (Figure 48) have been graphed. Similarly, production tonnages for the titanium dioxide and iron remelt produced in Quebec by QIT-Fer et Titane inc. were published for many fewer years than production values have been published. For this reason, production tonnages (Figures 13 and 62) and production values in 2001 dollars (Figures 14 and 63) have both been graphed.

Subsequent to 1946, although production tonnages for all of the mineral commodities produced in Canada have actually been gathered and compiled by Statistics Canada, or by Natural Resources Canada, in order to preserve confidentiality of company production data, production tonnages and values have not been published for certain commodities produced at only a few operations. For this reason, for some mineral commodities, it is impossible to graphically portray any production tonnages whatsoever. For others, the availability of publishable production statistics has been intermittent through the years. As a result, production graphs for those commodities are intermittent. The footnotes to the production graphs indicate the years for which production data are either confidential or otherwise unavailable (and so cannot be graphed). The mineral commodities for which production statistics have been confidential over the entire period of production and production statistics for other mineral commodities produced for only a few years are listed in Table 1.

IS CANADA'S MINERAL PRODUCTION DECLINING?

In inflation-adjusted dollars, the value of Canada's non-petroleum mineral production peaked in 1981 and then generally declined (Figure 73). The question is whether this decline occurred because of an actual decline in gross mineral production tonnages or because of declines in the prices of many of the mineral commodities that Canada has produced.

The inflation-adjusted value of Canada's metallic mineral production (Figure 74) peaked in 1979 and has generally declined since then. If the annual production tonnages of all the metallic minerals produced in Canada since 1886 are all valued at mid-2002 metal prices (Figure 75), except for a decline in gross metal production in the second half of the 1970s and the early 1980s, Canada's metallic mineral production appears to have been about stable over the past 30 years. Canadian production of some metals (copper, zinc, lead, silver and molybdenum) is expected to decline over the next 25 years, but these declines are likely to be compensated for by anticipated production increases for other metals.

Although such an analysis has not yet been carried out for the nonmetallic, non-petroleum minerals produced in Canada, it is probable that, as with the metals, there has not been any physical decline in the overall production of those nonmetals valued at 2002 prices.

HISTORICAL PRODUCTION OF CRUDE OIL, NATURAL GAS AND NATURAL GAS LIQUIDS

Although not included in this chapter, graphs depicting annual historical Canadian production volumes and values of crude petroleum, natural gas and natural gas liquids can be found on page 42 of the publication entitled *A History of Mining and Mineral Exploration in Canada and Outlook for the Future* (available on the Internet at www.nrcan.gc.ca/mms/topi-suje/hist_e.htm).

SOURCES OF STATISTICAL DATA USED

The data in the graphs have been compiled from the following sources:

- Dominion Bureau of Statistics, 1948, *Chronological Record of Canadian Mining Events from 1604 to 1947 and Historical Tables of Mineral Production of Canada*, 93 pp. - source of annual production statistics for the years prior to 1947.
- Dominion Bureau of Statistics (annual publication), *Mineral Statistics of Canada* - source of annual production data for the years 1947 to 1963 inclusive.
- Newfoundland customs returns - a series of reports listing annual imports and exports that include mineral commodity export tonnages.
- Statistics Canada (annual publication 26-201), *General Review of the Mineral Industries (Mines, Quarries and Oil Wells)* - source of annual production data for the years 1964 to 2000 inclusive.
- Barr, Elinor, 1988, *Silver Islet: Striking it Rich in Lake Superior*. This book provided annual silver production data for the Silver Islet mine (in Lake Superior) from 1868 to 1883, data that are not available from any other source.
- Natural Resources Canada (and its predecessor departments) annual publication, *Canadian Minerals Yearbook*, provides production tonnages for some mineral commodities for years in which Statistics Canada has reported production as being confidential. Such data were either obtained from company annual reports or provided to NRCan commodity specialists by producing companies for publication purposes.
- Canadian company annual reports - for some mineral commodities, production data that Statistics Canada indicated as being confidential were available from the annual reports of the companies that produced those minerals.

Notes: (1) Information in this review was current as of February 28, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TABLE 1. ADDITIONAL MINERAL COMMODITIES THAT HAVE BEEN PRODUCED IN CANADA

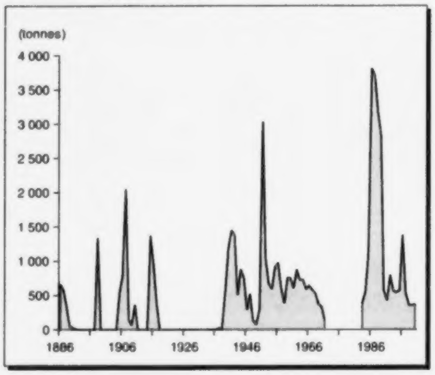
Mineral Commodity	Production Years	Production
Beryl	1929	2023 kg
Cesium	1986-2000	Confidential (there was production of the cesium-rubidium mineral pollucite in Canada prior to 1985 but statistics were not compiled)
Helium (1)	1963-77	Confidential
Marl	1985-2000	Confidential
Natro-alunite	1921-23, 1925, 1927	1921 - 27 t, 1922 - 45 t, 1923 - 14 t, 1925 - 18 t, 1927 - 6 t
Potassium sulphate	1988-2000	Confidential (produced from sodium sulphate that was not included in sodium sulphate production statistics)
Rhenium	1985-95	Confidential (there was production of rhenium in Canada prior to 1985 but statistics were not compiled)
Rubidium	1987-93, 1995	Confidential (see cesium)
Serpentine	1986-2000	
Strontium	1955-56, 1985-86	1955 - 44 t, 1956 - 68 t, 1985-86 - confidential
Thallium	1944, 1955	1944 - 58 kg, 1955 - 125 kg
Thorium (ThO_2)	1959-69	1959 - 21 t, 1960-65 - confidential, 1966 - 39 t, 1967 - 53 t, 1968 - 63 t, 1969 - 13 t
Tremolite	1986-2000	Confidential
Wollastonite	1998, 2000	Confidential
Zeolite	1994-2000	Confidential

(1) Helium is a gas, not a mineral.

List of Figures

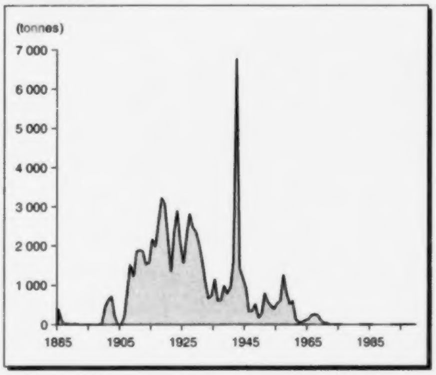
		Page
Metals and Metal Ores	Figures 1 to 31	8.6
Industrial Minerals	Figures 32 to 64	8.11
Construction Materials and Manufactured Products	Figures 65 to 70	8.16
Non-Petroleum Mineral Fuels	Figures 71 and 72	8.17
Value of Mineral Production	Figures 73 to 75	8.18

Figure 1
Canadian Antimony Ore and Antimony Production, 1886-2000



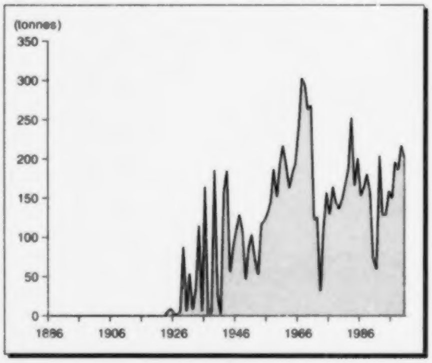
Sources: Natural Resources Canada; Statistics Canada.
Notes: Production for 1886-1925 is antimony ore. Production for 1937-2000 is antimony metal plus metal in ores exported. Production for 1972-82 is confidential.

Figure 2
Canadian Arsenic Production, 1885-1990



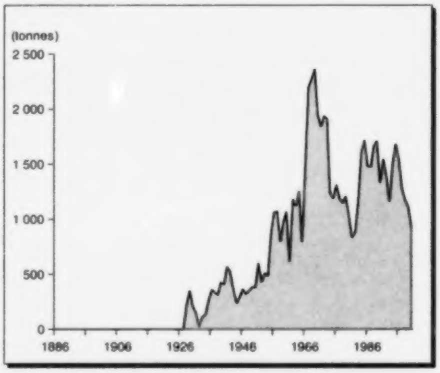
Sources: Natural Resources Canada; Statistics Canada.

Figure 3
Canadian Bismuth Production, 1924-2000



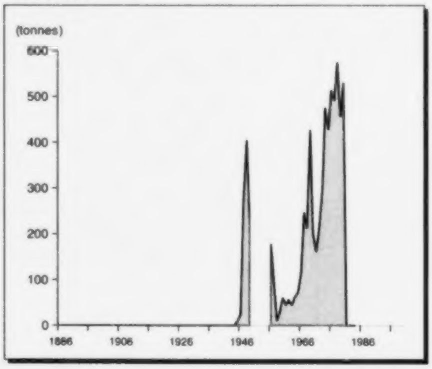
Sources: Natural Resources Canada; Statistics Canada.

Figure 4
Canadian Cadmium Production, 1928-2000



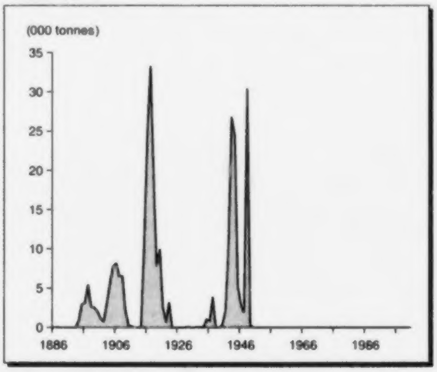
Sources: Natural Resources Canada; Statistics Canada.

Figure 5
Canadian Calcium Production, 1886-2000



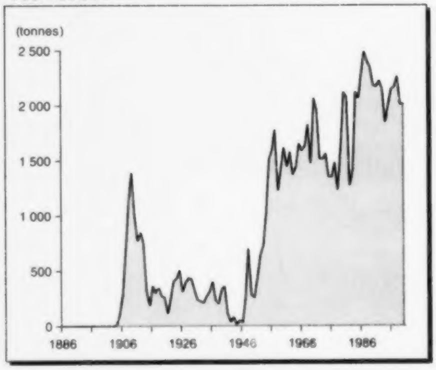
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1950-55 and 1985-2000 is confidential.

Figure 6
Canadian Chromite Production, 1886-1949



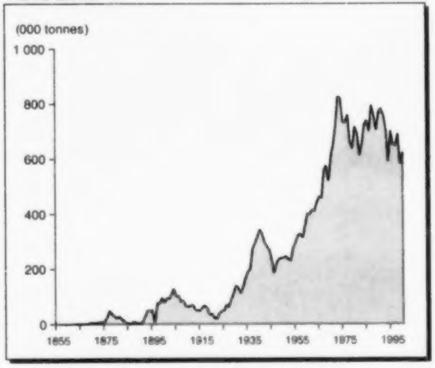
Sources: Natural Resources Canada; Statistics Canada.

Figure 7
Canadian Cobalt Production, 1904-2000



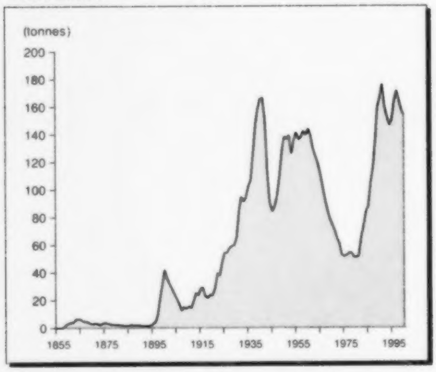
Sources: Natural Resources Canada; Statistics Canada.

Figure 8
Canadian Copper Production, 1848-2000



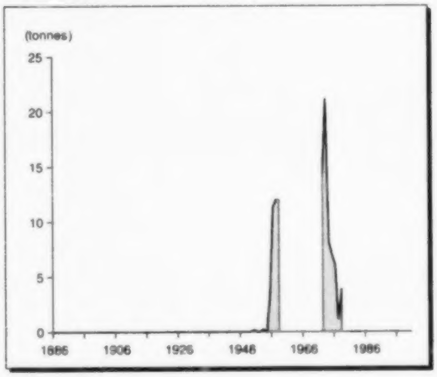
Sources: Natural Resources Canada; Statistics Canada.
Note: Canada (other than Newfoundland) produced a cumulative total of 100 000 t of copper from 1848 to 1885 that is not shown in this graph.

Figure 9
Canadian Gold Production, 1858-2000



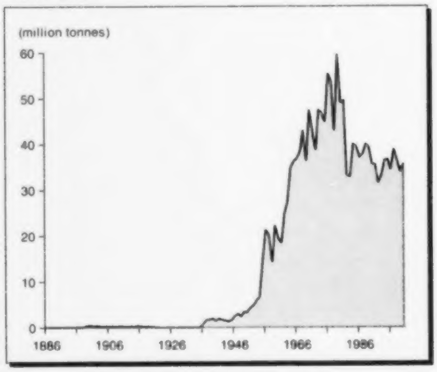
Sources: Natural Resources Canada; Statistics Canada.

Figure 10
Canadian Indium Production, 1942-2000



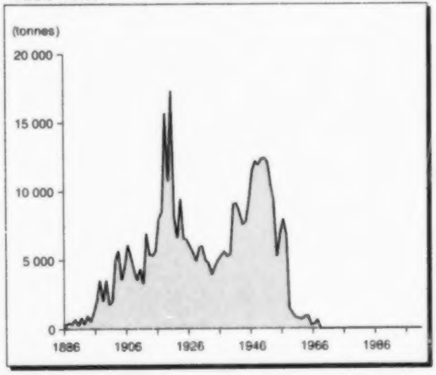
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1959-71, 1978-79 and 1985-2000 is confidential.

Figure 11
Canadian Iron Ore Production, 1876-2000



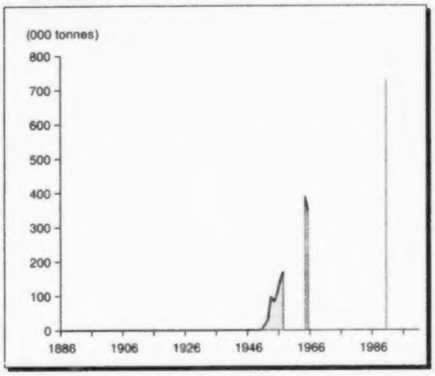
Sources: Natural Resources Canada; Statistics Canada.

Figure 12
Canadian Iron Oxide Production, 1886-1967



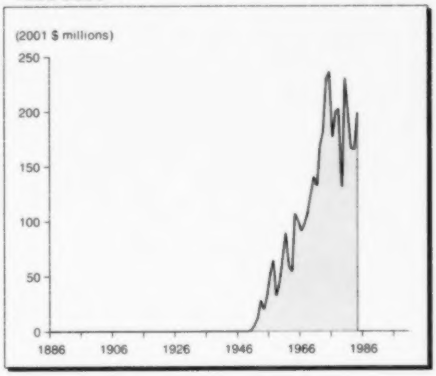
Sources: Natural Resources Canada; Statistics Canada.

Figure 13
Canadian Iron Remelt Production, 1950-2000



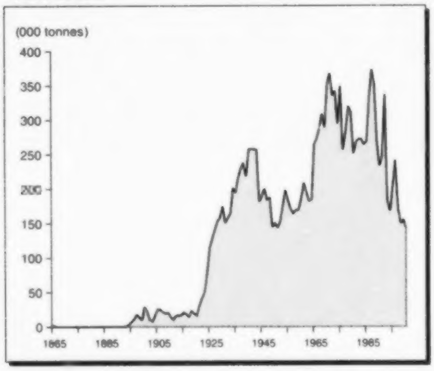
Sources: Natural Resources Canada; Statistics Canada.
Notes: Production for 1958-63, 1966-89 and 1991-2000 is confidential. See Figure 14, which indicates production values for 1950-86.

Figure 14
Value of Canadian Iron Remelt Production, 1950-2000



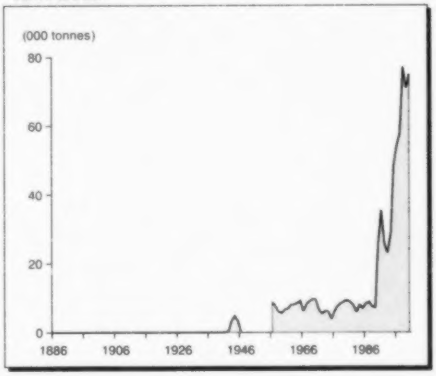
Sources: Natural Resources Canada; Statistics Canada.
Notes: See Figure 13 for available production tonnages. Production values for 1985-2000 are confidential.

Figure 15
Canadian Lead Production, 1865-2000



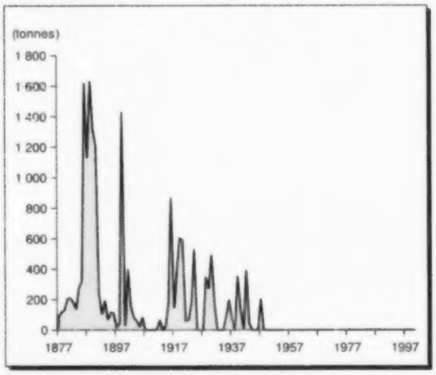
Sources: Natural Resources Canada; Statistics Canada.

Figure 16
Canadian Magnesium Production, 1941-2000



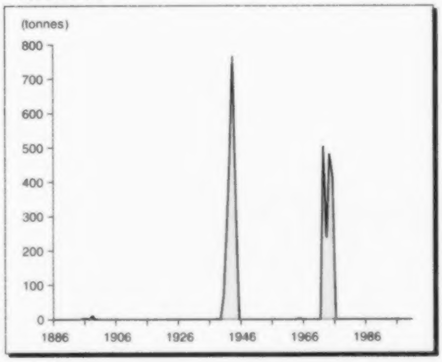
Sources: Natural Resources Canada; Statistics Canada.

Figure 17
Canadian Manganese Ore Production, 1877-1956



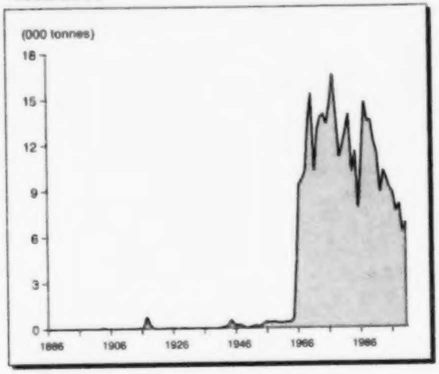
Sources: Natural Resources Canada; Statistics Canada.

Figure 18
Canadian Mercury Production, 1895-1975



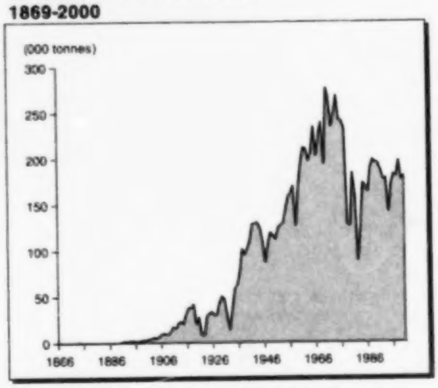
Sources: Natural Resources Canada; Statistics Canada.

Figure 19
Canadian Molybdenum Production, 1902-2000



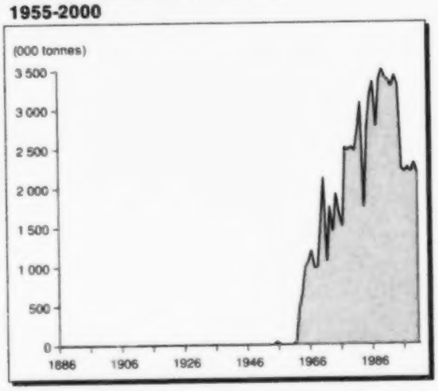
Sources: Natural Resources Canada; Statistics Canada.

Figure 20
Canadian Nickel Production, 1869-2000



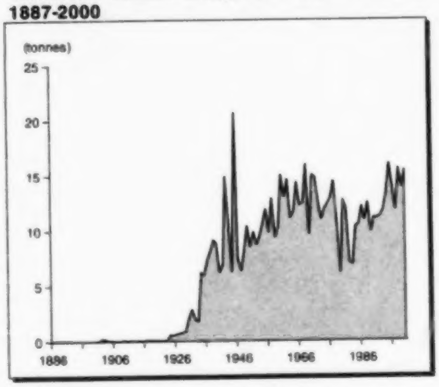
Sources: Natural Resources Canada; Statistics Canada.

Figure 21
Canadian Niobium Production, 1955-2000



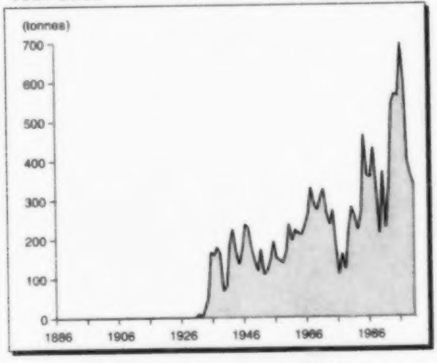
Sources: Natural Resources Canada; Statistics Canada.

Figure 22
Canadian Platinum Group Metals Production, 1887-2000



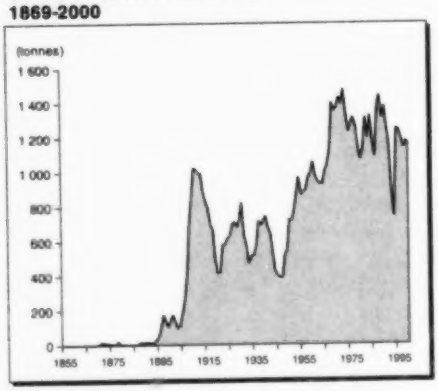
Sources: Natural Resources Canada; Statistics Canada.

Figure 23
Canadian Selenium Production, 1931-2000



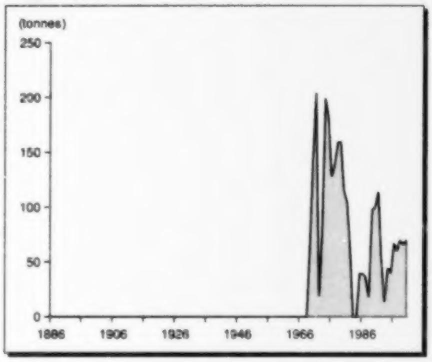
Sources: Natural Resources Canada; Statistics Canada.

Figure 24
Canadian Silver Production, 1869-2000



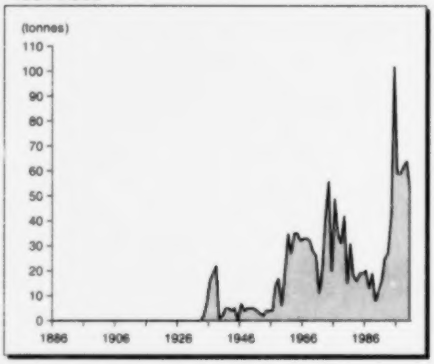
Sources: Natural Resources Canada; Statistics Canada.

Figure 25
Canadian Tantalum Production, 1969-2000



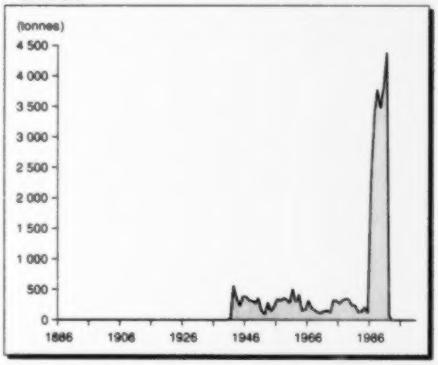
Sources: Natural Resources Canada; Statistics Canada.

Figure 26
Canadian Tellurium Production, 1934-2000



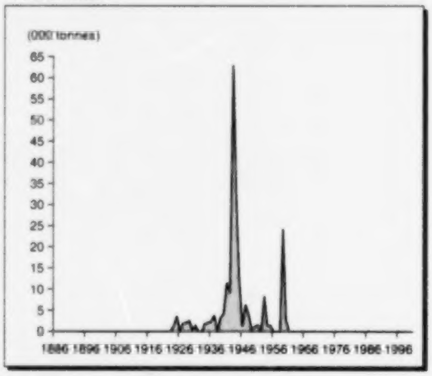
Sources: Natural Resources Canada; Statistics Canada.

Figure 27
Canadian Tin Production, 1941-92



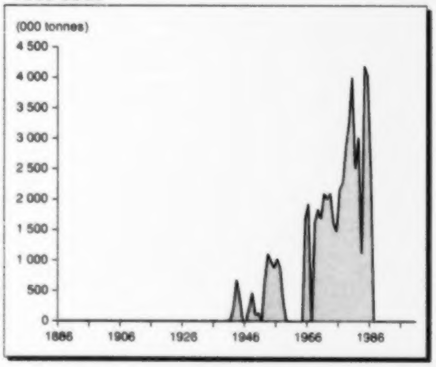
Sources: Natural Resources Canada; Statistics Canada.

Figure 28
Canadian Titanium Ore Production, 1886-1960



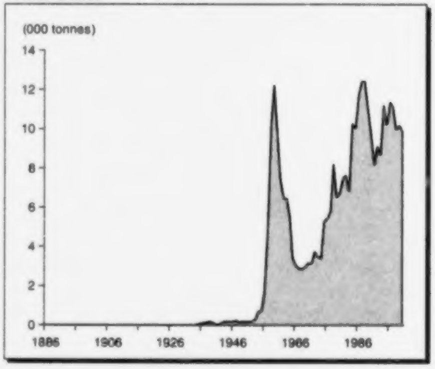
Sources: Natural Resources Canada; Statistics Canada.
Note: Excludes ilmenite produced by QIT-Fer et Titane inc., which is reported as iron remelt and as titanium dioxide.

Figure 29
Canadian Tungsten Production, 1939-2000



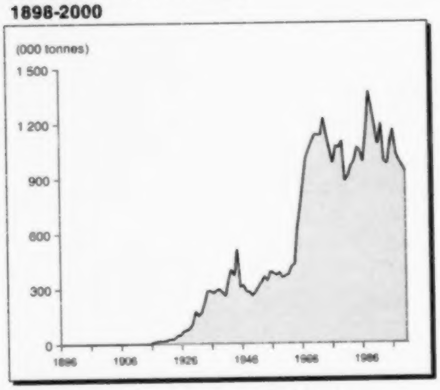
Sources: Natural Resources Canada; Statistics Canada.
Note: Tungsten production resumed in 2002.

Figure 30
Canadian Uranium Production, 1933-2000



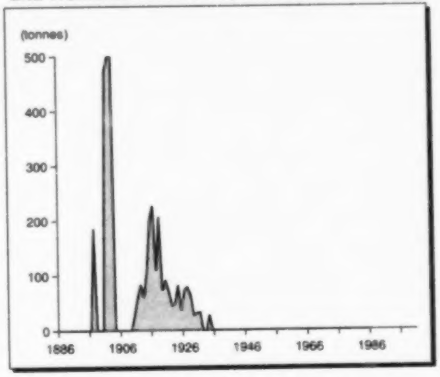
Sources: Natural Resources Canada; Statistics Canada.

Figure 31
Canadian Zinc Production, 1898-2000



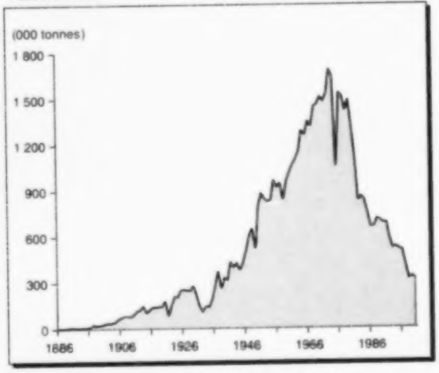
Sources: Natural Resources Canada; Statistics Canada.

Figure 32
Canadian Actinolite Production, 1897-1934, and Tremolite Production, 1986-2000



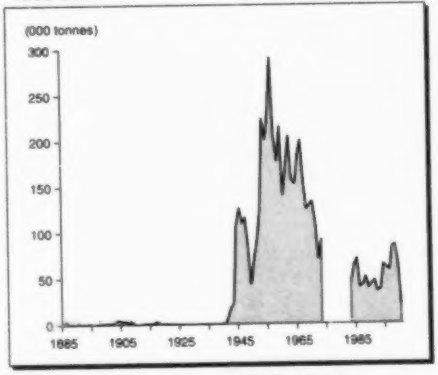
Sources: Natural Resources Canada; Statistics Canada.
Note: Tremolite production for 1986-2000 is confidential.

Figure 33
Canadian Asbestos Production, 1880-2000



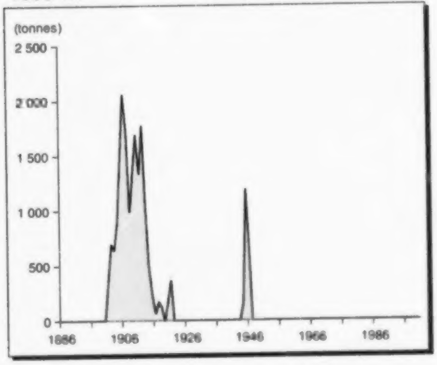
Sources: Natural Resources Canada; Statistics Canada.

Figure 34
Canadian Barite Production, 1885-2000



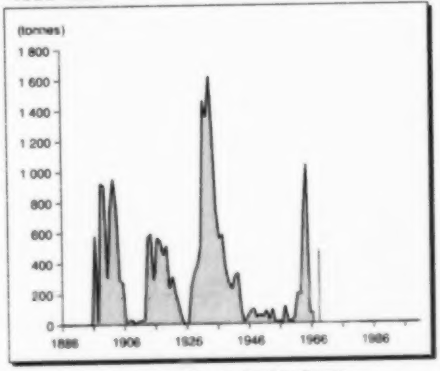
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1974-82 is confidential.

Figure 35
Canadian Corundum Production, 1900-46



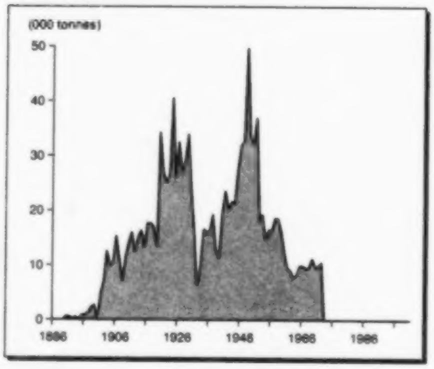
Sources: Natural Resources Canada; Statistics Canada.

Figure 36
Canadian Diatomite Production, 1886-1980



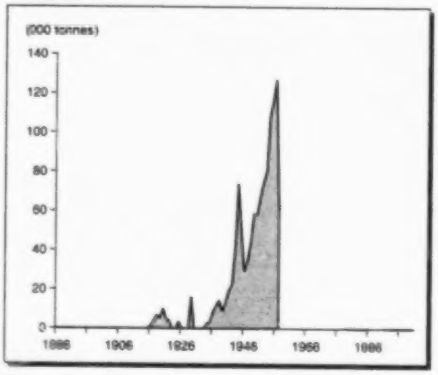
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1967 and 1969-80 is confidential.

Figure 37
Canadian Feldspar Production, 1890-1972



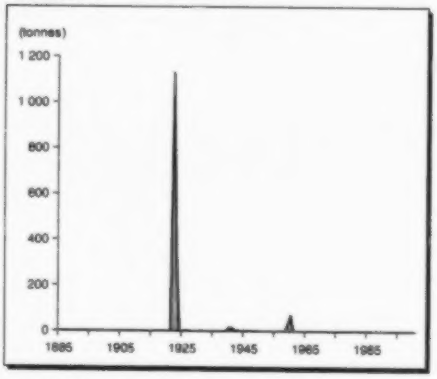
Sources: Natural Resources Canada; Statistics Canada.

Figure 38
Canadian Fluorspar Production, 1905-90



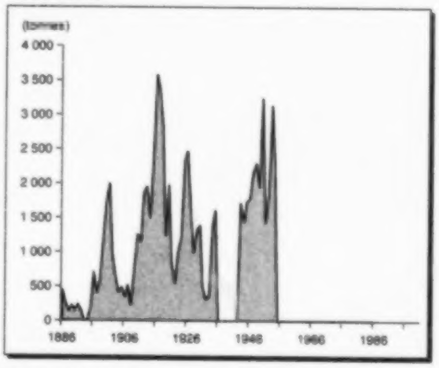
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1958-74, 1976-77 and 1987-90 is confidential.

Figure 39
Canadian Garnet Production, 1923-61



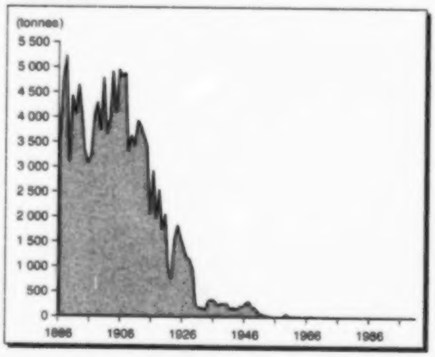
Sources: Natural Resources Canada; Statistics Canada.

Figure 40
Canadian Graphite Production, 1886-2000



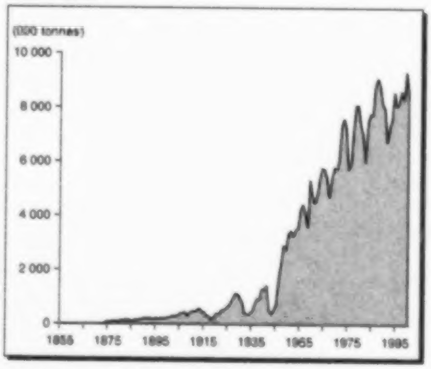
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1987-2000 is confidential.

Figure 41
Canadian Production of Natural Grindstones, 1886-1967



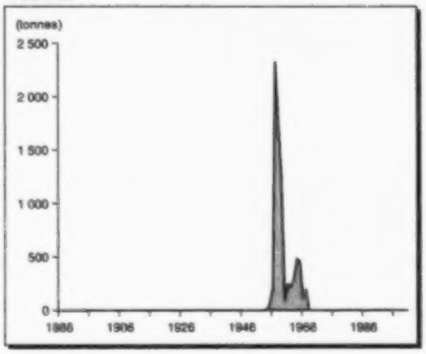
Sources: Natural Resources Canada; Statistics Canada.

Figure 42
Canadian Gypsum Production, 1874-2000



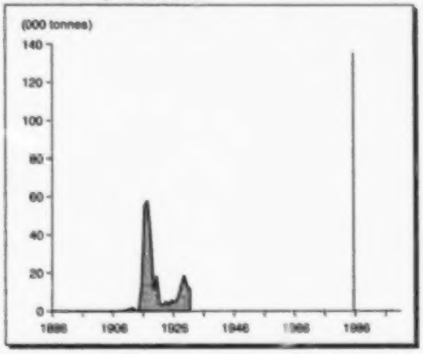
Sources: Natural Resources Canada; Statistics Canada.
Note: Newfoundland gypsum production for the years prior to 1949 is not available.

Figure 43
Canadian Lithia Production, 1954-67



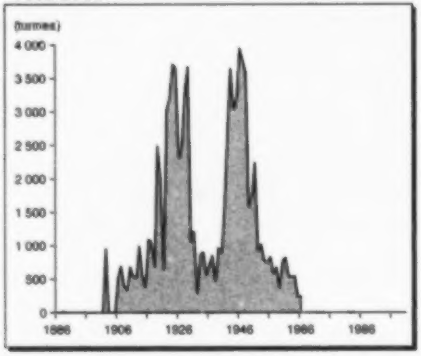
Sources: Natural Resources Canada; Statistics Canada.

Figure 44
Canadian Magnesitic Dolomite and Brucite Production, 1908-2000



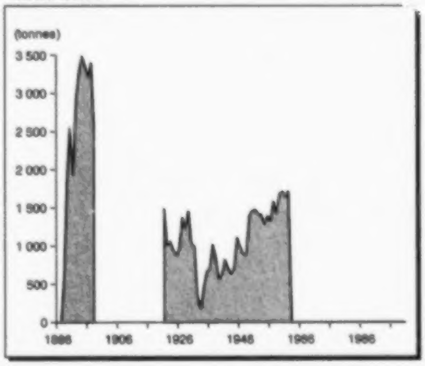
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1932-84 and 1986-2000 is confidential.

Figure 45
Canadian Mica Production, 1902-2000



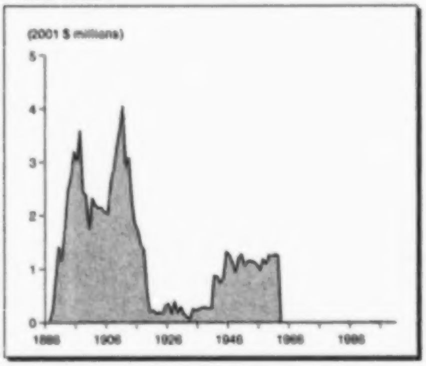
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1967, 1975-80 and 1986-2000 is confidential.

Figure 46
Canadian Mineral Water Production, 1888-1962



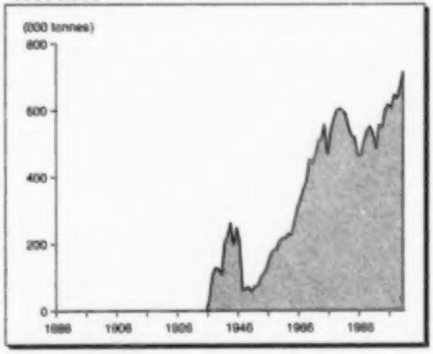
Sources: Natural Resources Canada; Statistics Canada.
Notes: Production tonnages for 1899-1920 are not available (see Figure 47, production value). The production of mineral water from natural sources has resumed in Canada in recent years, but production statistics are not available.

Figure 47
Value of Canadian Mineral Water Production, 1888-1962



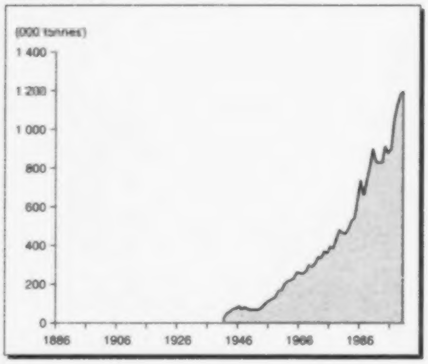
Sources: Natural Resources Canada; Statistics Canada.
Note: The production of mineral water from natural sources has resumed in Canada in recent years, but production statistics are not available.

Figure 48
Canadian Nepheline Syenite Production, 1936-2000



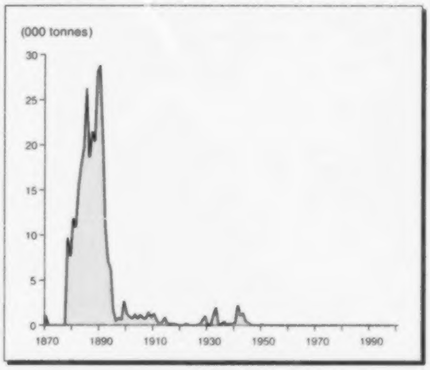
Sources: Natural Resources Canada; Statistics Canada.

Figure 49
Canadian Peat Moss Production, 1941-2000



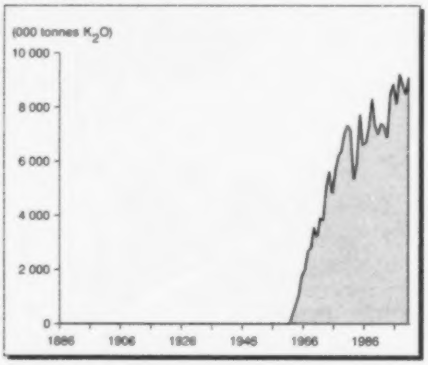
Sources: Natural Resources Canada; Statistics Canada.
Notes: This graph does not include a cumulative total of about 40 000 t of peat fuel produced between 1900 and 1955. See Figure 72 for peat fuel production.

Figure 50
Canadian Phosphate Production, 1870-2000



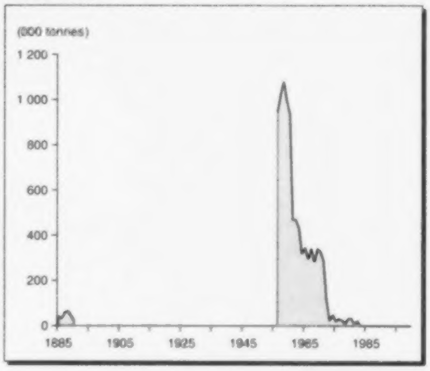
Sources: Natural Resources Canada; Statistics Canada.
Notes: Phosphate production resumed in 1999 but is confidential. Current production is much higher than the highest shown here.

Figure 51
Canadian Potash Production, 1958-2000



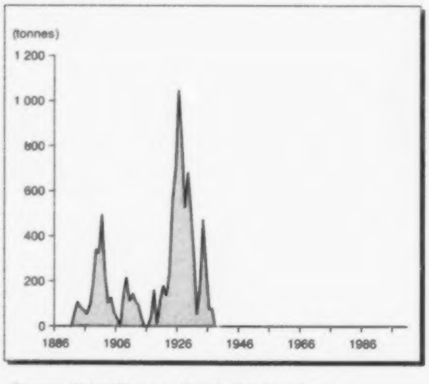
Sources: Natural Resources Canada; Statistics Canada.
Note: The graph does not show the minor production from one mine in 1958 and 1959.

Figure 52
Canadian Pyrite and Pyrrhotite Production, 1885-1982



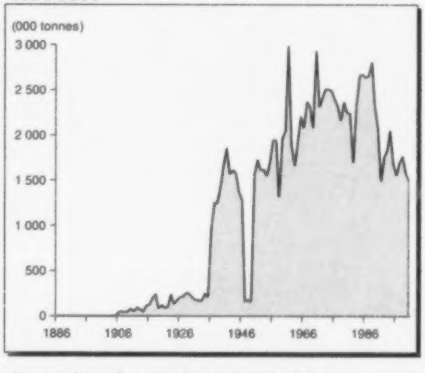
Sources: Natural Resources Canada; Statistics Canada.
Note: Pyrite was also produced from 1883 to 1955 inclusive, but was reported as sulphur content of pyrite and smelter gas.

Figure 53
Canadian Production of Natural Pulpstones, 1892-1937



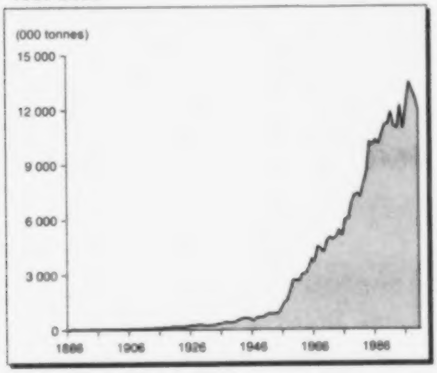
Sources: Natural Resources Canada; Statistics Canada.

Figure 54
Canadian Quartz (Silica) Production, 1890-2000



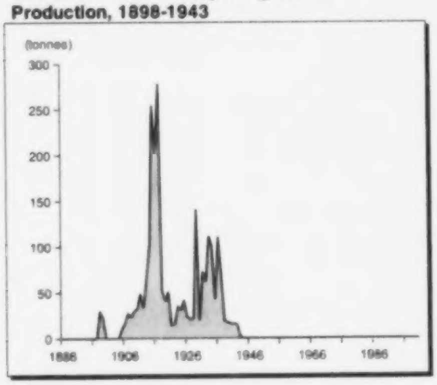
Sources: Natural Resources Canada; Statistics Canada.

Figure 55
Canadian Salt Production, 1886-2000



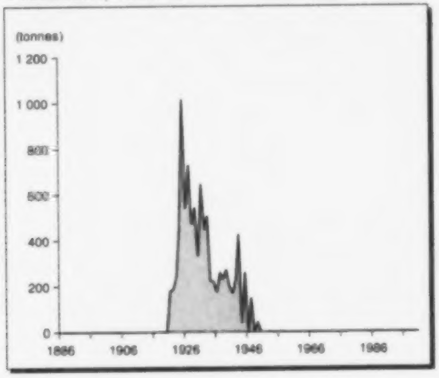
Sources: Natural Resources Canada; Statistics Canada.

Figure 56
Canadian Natural Sharpening Stones Production, 1898-1943



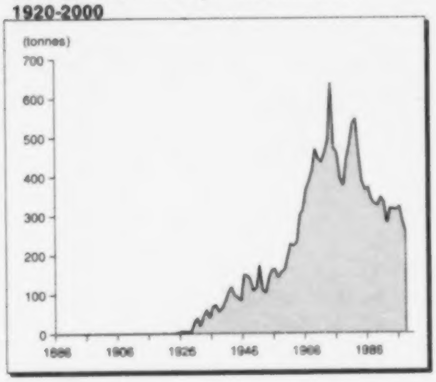
Sources: Natural Resources Canada; Statistics Canada.

Figure 57
Canadian Sodium Carbonate (Natural) Production, 1921-49



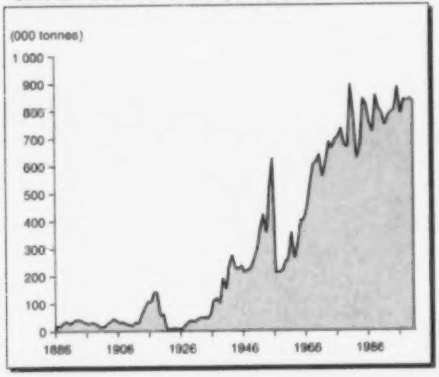
Sources: Natural Resources Canada; Statistics Canada.

Figure 58
Canadian Sodium Sulphate Production, 1920-2000



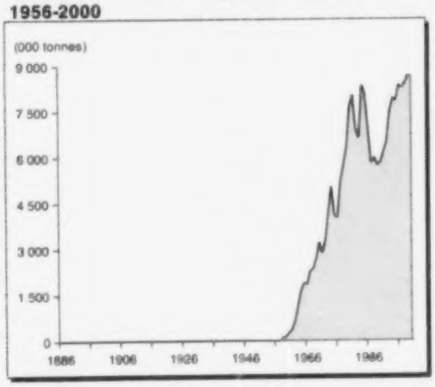
Sources: Natural Resources Canada; Statistics Canada.
Note: Production for 1999-2000 is confidential.

Figure 59
Sulphur Content of Canadian Pyrite and Smelter Gas Production, 1886-2000



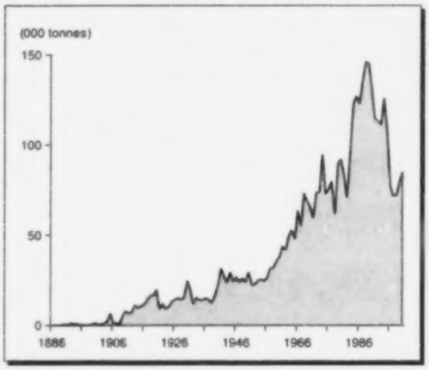
Sources: Natural Resources Canada; Statistics Canada.

Figure 60
Canadian Elemental Sulphur Production, 1956-2000



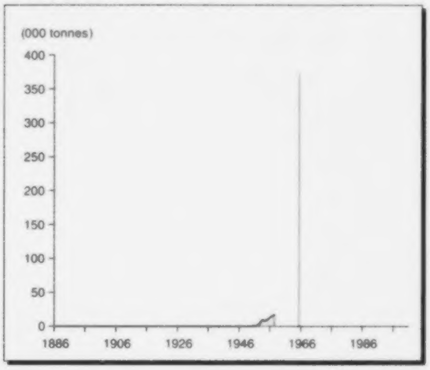
Sources: Natural Resources Canada; Statistics Canada.
Note: Production of sulphur in SO_2 smelter gases, and in pyrite and pyrrhotite concentrates, is not included.

Figure 61
Canadian Talc, Soapstone and Pyrophyllite Production, 1886-2000



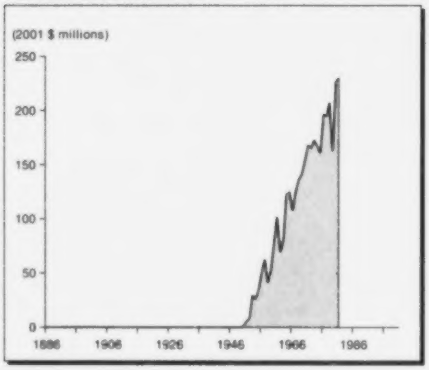
Sources: Natural Resources Canada; Statistics Canada.

Figure 62
Canadian Titanium Dioxide Production, 1950-2000



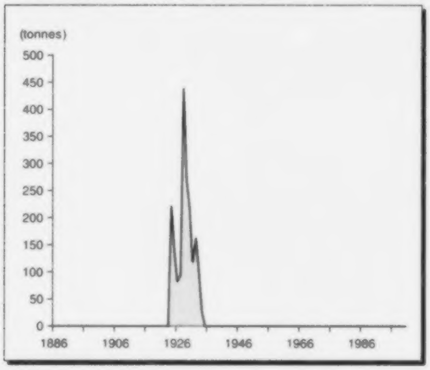
Sources: Natural Resources Canada; Statistics Canada.
Notes: Production for 1958-64 and 1966-2000 is confidential. See Figure 63, which indicates production values for 1950-82.

Figure 63
Value of Canadian Titanium Dioxide Production, 1950-2000



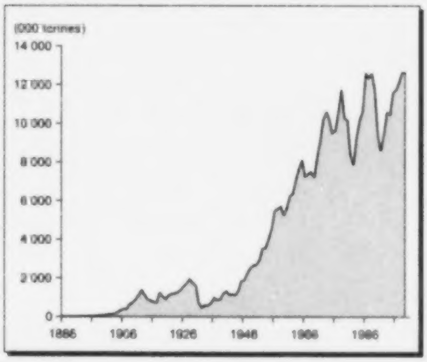
Sources: Natural Resources Canada; Statistics Canada.
Note: See Figure 62 for available production tonnages.

Figure 64
Canadian Volcanic Dust (Pumice) Production, 1924-2000



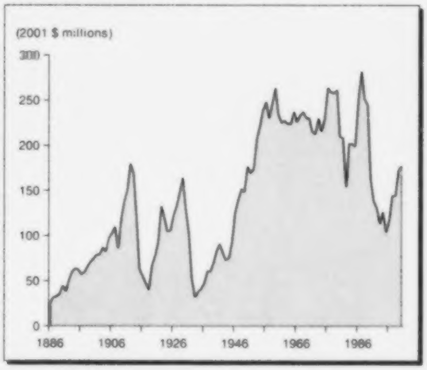
Sources: Natural Resources Canada; Statistics Canada.
Note: Pumice production for 1995-2000 is confidential.

Figure 65
Canadian Cement Production, 1887-2000



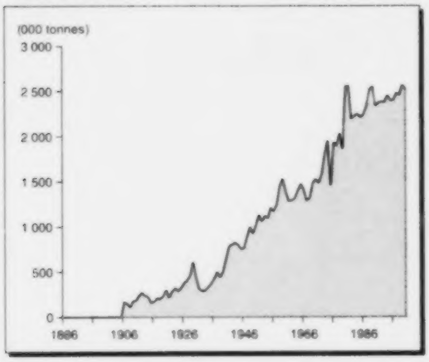
Sources: Natural Resources Canada; Statistics Canada.

Figure 66
Value of Canadian Production of Clay Products, 1886-2000



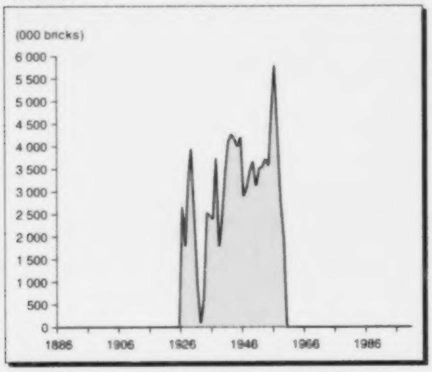
Sources: Natural Resources Canada; Statistics Canada.
Note: Newfoundland clay products production for the years prior to 1949 is not available.

Figure 67
Canadian Lime Production, 1906-2000



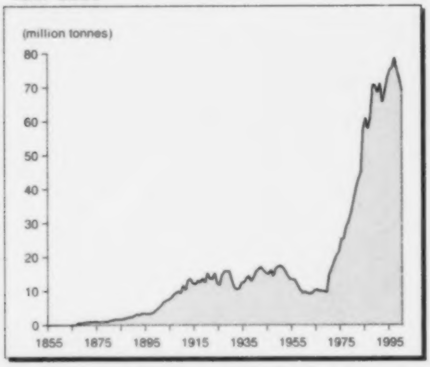
Sources: Natural Resources Canada; Statistics Canada.

Figure 69
Canadian Silica Brick Production, 1926-59



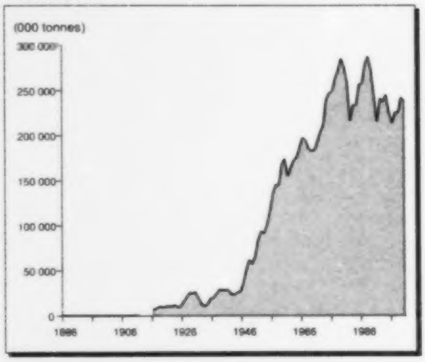
Sources: Natural Resources Canada; Statistics Canada.

Figure 71
Canadian Coal Production, 1867-2000



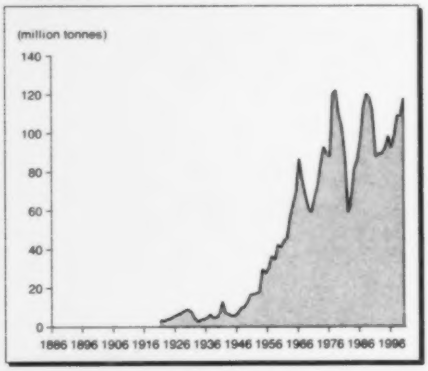
Sources: Natural Resources Canada; Statistics Canada.
Note: Canada produced a cumulative total of 2.6 Mt of coal from 1785 to 1866.

Figure 68
Canadian Sand and Gravel Production, 1886-2000



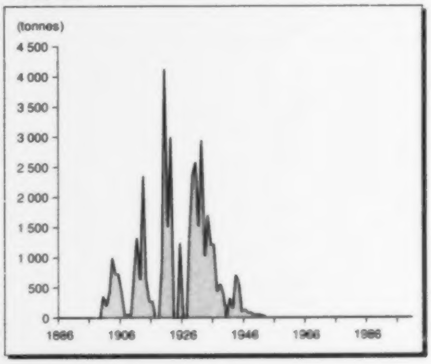
Sources: Natural Resources Canada; Statistics Canada.
Notes: Production for 1912-15 is not available. Newfoundland sand and gravel production for the years prior to 1949 is not available.

Figure 70
Canadian Stone Production, 1886-2000



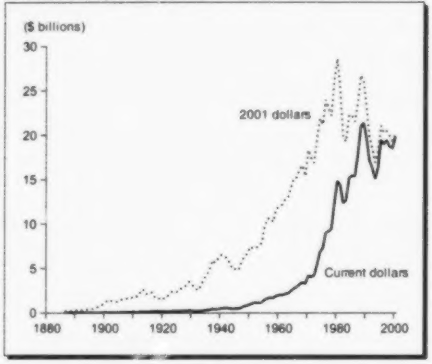
Sources: Natural Resources Canada; Statistics Canada.
Notes: Stone production for 1886-1920 is not available. Newfoundland stone production for the years prior to 1949 is not available.

Figure 72
Canadian Peat Fuel Production, 1900-52



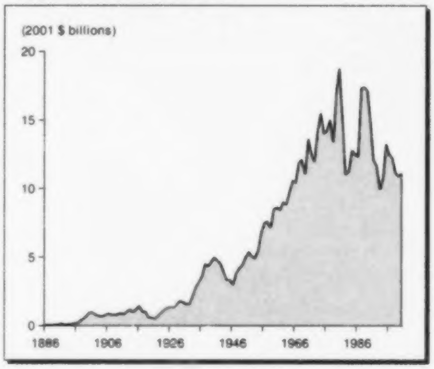
Sources: Natural Resources Canada; Statistics Canada.

Figure 73
Value of Canada's Non-Petroleum Mineral Production, 1886-2000



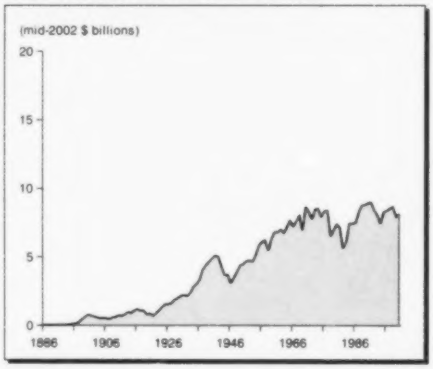
Sources: Statistics Canada; Natural Resources Canada.
Note: Production value statistics prior to 1886 are incomplete.

Figure 74
Value of Canadian Metallic Mineral Production, 1886-2000 in 2001 Dollars



Sources: Natural Resources Canada; Statistics Canada.

Figure 75
Value of Canadian Metallic Mineral Production, 1886-2000, at Mid-2002 Metal Prices



Sources: Natural Resources Canada; Statistics Canada.

Aluminum

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Notes: This year, general material on aluminum has been removed from this document. For this material, please see last year's article (available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html). Schoolnet material on aluminum is available at www.nrcan.gc.ca/mms/cmy/mfs_e.htm. General information for educators is available at www.nrcan.gc.ca/mms/scho-ecol/toc_e.htm. The abbreviations of company names used in this review are listed in Table 10 along with the Internet addresses of those companies.

Canadian 2001 primary metal production:	2.6 Mt
Value of primary production:	$5.8 billion^{P}
World rank:	Fourth
2001 exports (unwrought):	$4.91 billion
Installed capacity:	2.7 Mt/y

Increases in production at existing and new facilities around the world did not offset reductions in metal production in the Americas. As a result, world production of primary and recycled aluminum decreased in 2001 to an estimated total of 32.4 Mt, compared to the record 32.9 Mt in 2000. Of this total, 24.5 Mt was primary material, compared to 24.6 Mt in 2000.

Aluminum prices declined throughout the year until November when prices started to recover (see the table opposite).

The alumina market continued a downward trend that started in 2000 as expansions and higher utilization rates of existing capacity increased supplies. *Metal Bulletin* reported that spot prices for metallurgical-grade alumina declined from US$165-$180/t in late 2000 to US$140-$150/t in early 2002.

PRIMARY ALUMINUM CASH PRICE, LONDON

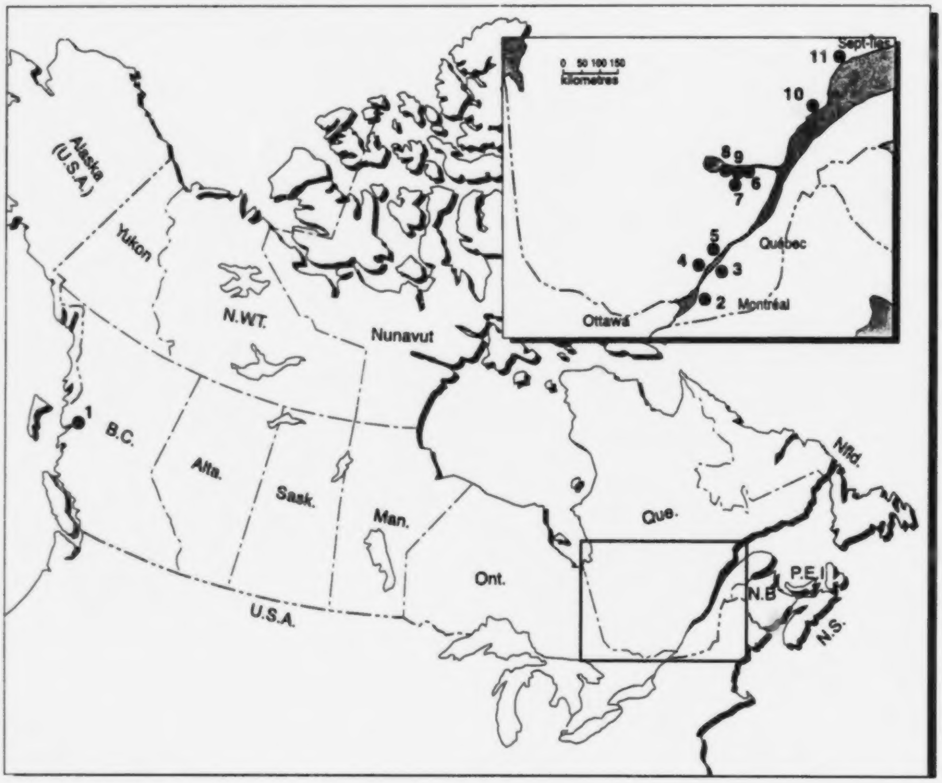
	1999	2000	2001
		US$/t (US¢/lb)	
Year average	1 362 (62)	1 555 (71)	1 444 (66)
Start of year	1 214 (55)	1 615 (73)	1 567 (71)
End of year	1 630 (74)	1 554 (71)	1 335 (61)
Year high	1 630 (74)	1 745 (79)	1 737 (79)
Year low	1 140 (52)	1 400 (63)	1 243 (56)

CANADIAN DEVELOPMENTS

Canadian production of primary aluminum increased by almost 9% to 2.583 Mt in 2001 from 2.374 Mt in 2000. The increase resulted from the ramp-up in production at Alcan's new 400 000-t/y smelter at Alma, Quebec, which reached full capacity production in September 2001. Alma replaces the 72 000-t/y Isle Maligne smelter, which was decommissioned in 2000. Canada now ranks fourth after China, Russia and the United States in terms of world production. The value of Canadian production, estimated at $5.8 billion, compared to $5.5 billion in 2000, reflects this increase in metal production. Monthly Canadian production statistics can be obtained on Natural Resources Canada's Internet site at www.nrcan.gc.ca/mms/efab.

The Canadian aluminum industry has made major strides in reductions in greenhouse gas emissions per tonne of aluminum produced over the last 10 years whereby the intensity of emissions has fallen from 5.1 t of CO_2 equivalent in 1990 to 3.4 t in 2000. However, total emissions have not fallen in the same ratio due to increased production volumes over the same time period. In January 2002, the Aluminium Association of Canada and the Government of Quebec signed a framework agreement on the voluntary reduction of an additional 200 000 t of greenhouse gas emissions from Quebec smelters by the end of 2007. The agreement proposes gradual, permanent reductions, allows for growth in the Quebec aluminum industry, and acknowledges the importance of aluminum's life cycle and contribution to the collective effort to reduce greenhouse gas emissions. Refer to the Association's web site at www.aia.aluminium.qc.ca for further details.

Figure 1
Aluminum Smelters, 2000


0 50 100 150
kilometres
Sept-Îles
11
10
8
9
6
7
5
4
3
2
Québec
Montréal
Ottawa
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
1
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.

SMELTER	**COMPANY**	**CAPACITY (t/y)**
1. Kitimat	Alcan	272 000
2. Beauharnois	Alcan	50 000
3. Bécancour	A.B.I.	390 000
4. Shawinigan	Alcan	91 000
5. Lauralco Deschambault	Alcoa Lauralco	240 000
6. Grande-Baie	Alcan	196 000
7. Laterrière	Alcan	219 000
Alma	Alcan	400 000[a]
8. Isle-Maligne	Alcan	25 000[b]
9. Arvida, Jonquière	Alcan	248 000
10. Baie-Comeau	Canadian Reynolds Metals (Alcoa)	418 000
11. Alouette	Alouette	244 000

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[a] Will reach full capacity in mid-2001. [b] The last potline closed permanently in March 2000.

Reported Canadian use of aluminum metal at the first processing stage, including recycled aluminum, was 1 015 640 t in 2000, up 2% from a revised figure of 999 242 t in 1999. Part of this increase was due to an increase in the number of companies reporting.[1]

Canada is the second largest aluminum-exporting country in the world after Russia. Canadian exports of primary smelter products in 2001 increased in quantity to 2.046 Mt valued at $4.914 billion, compared to 1.837 Mt valued at $4.52 billion (revised) in 2000. Of this amount, unwrought exports to the United States totalled 1.69 Mt valued at $4.11 billion, compared to 1.44 Mt valued at $3.62 billion in 2000 (Table 1a).

After discussions with Quebec aluminum companies on potential expansions, the Quebec government chose a proposal by Aluminerie Alouette Inc. and Alcan Inc. for use of a block of 500 MW of power at standard commercial rates. Aluminerie Alouette plans to invest $1.4 billion to expand the capacity of the smelter to 540 000 t/y. Preliminary work will begin this summer and the first metal is expected in 2005. In addition to the 2500 construction jobs, the expansion will create 340 new jobs at the smelter and 1500 jobs in other areas of the province. Further details are available on the company's web site at www.alouette.com.

As a result of Norsk Hydro ASA's purchase of VAW AG from E.ON., Norsk Hydro's subsidiary, Hydro Aluminium, now owns 20% of the Alouette smelter. Also, in February 2002, Alcan purchased the 20% share of the smelter held by the Société Générale de Financement du Québec. The other partners in the smelter include Aluminium Austria Metall Québec (20%), Corus Aluminium Québec Inc. (20%), Kobe Aluminium Canada Inc. (13.33%), and Marubeni Québec Inc. (6.66%).

Alcan Inc. celebrated the 100th anniversary of aluminum ingot production in Shawinigan, Quebec. The first primary aluminum ingot in Canada was produced in Shawinigan on October 22, 1901, by the Aluminum Company of America. The Aluminum Company of America in 1902 established a subsidiary, the Northern Aluminum Company, the precursor to the modern Alcan Inc.

Alcan signed a Memorandum of Understanding with Hydro-Québec in February 2002 to explore opportunities ranging from optimizing hydro-electric resources in the Saguenay–Lac-St-Jean region to providing the power that would be required to support the eventual expansion of Alcan's Alma smelter.

Alcan's 275 000-t/y Kitimat smelter in British Columbia suffered from low water levels in the Nechako Reservoir and it announced a slowdown of up to 50% of the plant's capacity. Higher levels of snow reported during the winter may alleviate the situation and Alcan announced in June 2002 a partial restart from 180 000 t/y to 240 000 t/y for August 2002. During the slowdown, Alcan (www.alcan.com) worked on studies for an expansion and pilot work on converting the smelter to pre-bake technology.

Alcoa continued investigating the possibility of expansions at its existing smelters, including all three of its smelters in Canada. When two of these smelters were first constructed, planning was done to allow easy expansion. Alcoa participated in discussions on power with the Quebec government and Hydro-Québec and obtained a 100-MW block of power to modernize the Baie-Comeau smelter. Discussions continue on power supply to allow a doubling of the Deschambault smelter.

Alcoa signed a letter of intent with Newfoundland and Labrador Hydro and the Province of Newfoundland and Labrador on a joint review of a possible hydro-electric power expansion and aluminum smelter located in that province. The review was completed in late 2001 and discussions were continuing (www.alcoa.com and www.gov.nf.ca).

In British Columbia, KTD L.L.C., an independent U.S.-based consulting firm, completed a pre-feasibility study for a new 360 000-t/y smelter to be located near Port Alberni, Vancouver Island. Results of the study indicated that the project was viable and work is under way to seek investors in the project. The proposed smelter will require 650 MW of power and new power generation and transmission infrastructure. In late 2001, KTD and officials from the town of Port Alberni expected a full feasibility study to start shortly, with full engineering and permitting studies expected to take up to three years followed by a 34-month construction period. A total of 650 direct jobs would be created with this proposed US$1.5 billion smelter. The smelter will use aluminum reduction technology from KTD. (Additional information is available at www.bchydro.bc.ca, www.alberni-region.com and www.ktdal.com.)

CANADIAN OUTLOOK

Canada is expected to produce about 2.7 Mt of primary aluminum in 2002, up from the 2.6 Mt produced in 2001. The increase will result from the full production rates of the new Alma smelter; however, it will also depend on power availability to the Kitimat smelter in northern British Columbia.

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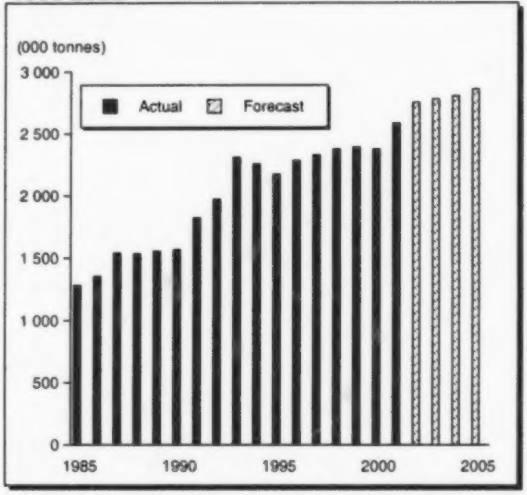
[1] NRCan Canadian aluminum use data for 2000 is from a survey based on responses from 178 Canadian companies using primary and recycled aluminum in scrap, ingot or liquid metal form. Scrap used in the production of recycled ingot is not included in "Use." These numbers may include limited amounts of run-around scrap. Work is under way to obtain clarification.

Canada's production capacity increased to over 2.7 Mt/y in 2001 with the completion of Alcan's Alma smelter. With the announced expansion of the Alouette smelter, capacity is now expected to be above 3 Mt/y in 2005. Other smelter expansion projects in Quebec (at Bécancour, Baie-Comeau and Deschambault) are dependent on the negotiation of additional long-term power supply contracts with Hydro-Québec. Decisions and the results of work on possible new capacity in British Columbia and in Newfoundland and Labrador are still pending.

Figure 2
Canadian Primary Aluminum Production, 1985-2005



Source: Natural Resources Canada.

In 2001, Canada's reported use of aluminum is expected to increase slightly from that used in 2000. Canada ranks sixth in primary aluminum use (see Table 9).

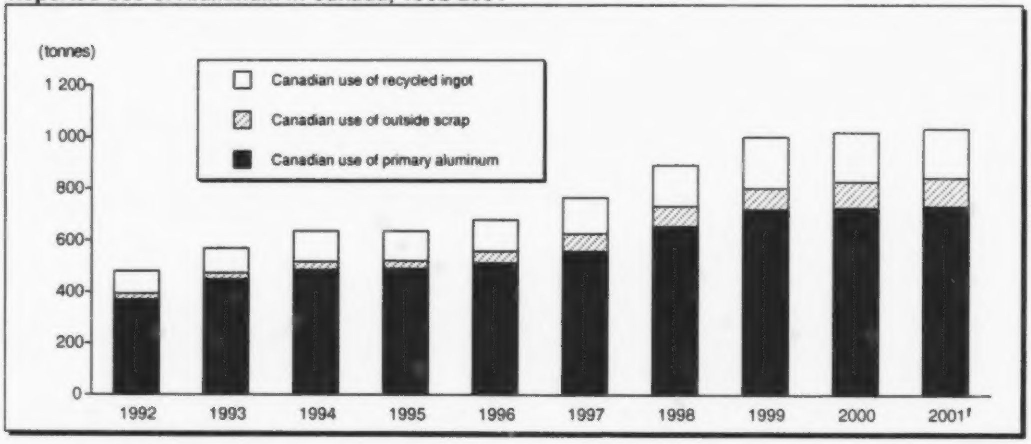
WORLD DEVELOPMENTS

China became the largest producer of primary aluminum in the world in 2001. Expansions and new projects, generally in incremental amounts, continue within the Chinese industry. China Aluminium Corp. (Chalco) issued shares in a public offering, in part to fund further expansion of its interests. As a result, the rate of expansion in Chalco's capacity may continue to accelerate. The State Development Planning Commission of the Chinese government has been reported as trying to slow the growth in production rates; however, expansions already under way will ensure China's lead in aluminum production.

A decline in the use of metals and metal-containing products with expanded production elsewhere countered much of the effect of production cutbacks in the Americas in 2001.

In 2001, producers continued to focus on cost reduction and increased competitiveness through

Figure 3
Reported Use of Aluminum in Canada, 1992-2001



Source: Natural Resources Canada.
[f] Forecast.
Note: The use of aluminum may be overstated; survey forms have been revised for 2001.

economies of scale through mergers, acquisitions and technological improvements to facilities. Larger corporate changes included:

- Norsk Hydro A.S.A. began discussions to acquire VAW Aluminium AG from E.ON. late in 2001 and the sale was completed in early 2002. Hydro Aluminum becomes the fourth largest aluminum producer in the world, now with a primary capacity of 1.4 Mt/y.
- In India, the government sold 51% of Bharat Aluminium Company Ltd. to Sterlite Industries.
- WMC started splitting itself into two companies to concentrate all of its aluminum assets within one of those companies.
- Further changes are expected in 2002 as, in late 2001, Corus Plc announced that it intended to divest its aluminum assets.

In the western United States, power costs have now declined from their highs. About 1.3 Mt/y of the total U.S. primary capacity of approximately 3.7 Mt/y has been closed. Although spot power prices have now fallen, the timing of restarts is still uncertain. (The Bonneville Power Administration [BPA] signed agreements with aluminum smelters to close for one to two years.) In late 2001 and early 2002, companies started to consider re-opening the closed capacity, although at reduced rates until new long-term power contracts can be finalized. Included in these plans are Columbia Falls Aluminum Co.'s restart of one potline at Columbia Falls, Montana, and an increase in production at Alcoa's Intalco smelter in Washington.

A lack of rainfall in Brazil forced rationing of power in mid-2001 for all users of power, including the aluminum industry. As a result, approximately 350 000 t/y of the country's capacity of 1.3 Mt/y was shut down. Production for the year was reported to have fallen by 11%. By year-end, however, restarts had begun and were nearly complete at the end of the first quarter of 2002.

Expansions, proposals and studies for new mines, refineries and smelters have been announced in many countries. Although the current weaker demand may delay some projects, a considerable amount of potential new production capacity is expected to be constructed in the near-term future. The projects reported include those listed in Tables 11 and 12.

The Federation of Aluminium Consumers in Europe (FACE) continued its efforts to promote the use of aluminum, assess the impact of new technologies, and reduce the costs of primary metal through tariff reductions to stimulate demand. FACE was formed in 1999 and has 44 members from European aluminum-using companies from 12 member states. As the European Union (EU) uses more than double the amount of primary aluminum it produces, FACE estimates that the EU's 6% duty on unwrought aluminum imports costs European consumers US$475 million per year. In 2001, FACE renewed efforts to achieve consensus among EU members to reduce the duty imposed on unwrought aluminum rather than through a reduced tariff quota. (FACE has an Internet site at www.facealuminium.com.)

RECYCLING

The World Bureau of Metal Statistics (WBMS) reports Western World production of recycled aluminum metal decreased to 7.9 Mt from 8.2 Mt in 2000, reflecting a combination of the lower global demand for aluminum and increased direct use of scrap in products. U.S. production, at 3.2 Mt, was the largest amount in any one country and represented approximately 40% of recycled aluminum production worldwide. (WBMS has a web site at www.wbms.dircon.co.uk.)

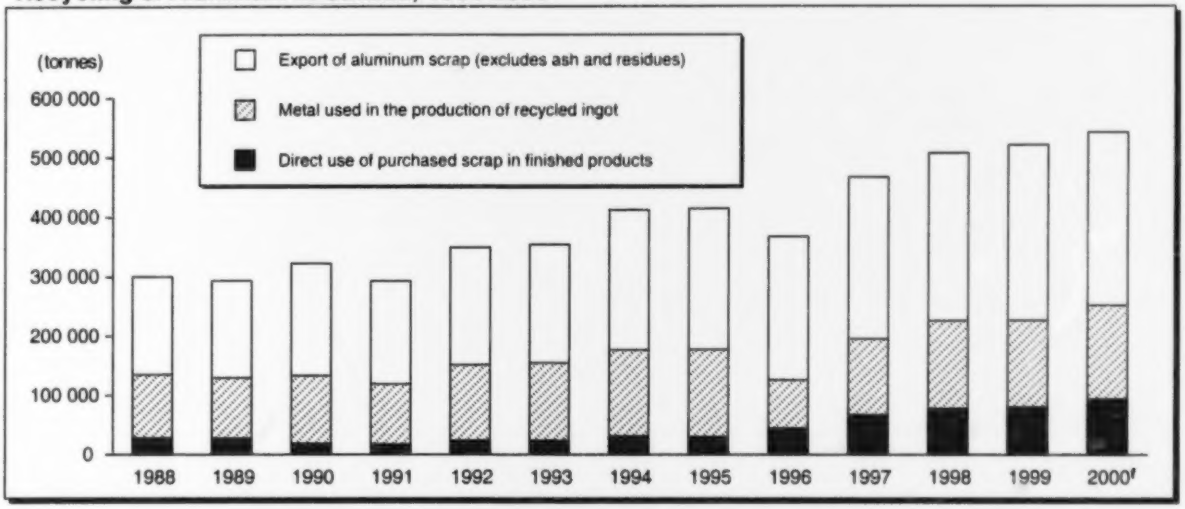
In May 2001, the U.S.-based Businesses and Environmentalists Allied for Recycling (BEAR) reported the results of Stage I of its Multi-Stakeholder Recovery Project on beverage containers, including those made of aluminum. The project brought together a diverse group of 17 stakeholders including The Container Recycling Institute (CRI), Coca-Cola, Waste Management, and Tomra North America to examine the state of beverage container recycling and compare the costs of various recycling systems. Included in the findings was the fact that higher volumes of used beverage containers were recovered in states with deposit laws. Further information is available on the Internet at www.container-recycling.org.

Reported Canadian use of outside scrap (scrap aluminum obtained from other companies) for the direct production of semi-finished or finished products was 100 294 t in 2000, up substantially from the 80 689 t reported in 1999. The use of outside scrap in 2001 is estimated to be approximately equivalent to that in 2000. The reported use of purchased recycled aluminum ingot was 190 026 t in 2000, down from the record 199 429 t reported in 1999. The reported use of aluminum metal, including scrap used in the production of recycled aluminum ingot, was 159 419 t in 2000, up from the 145 959 t reported in 1999 (refer to Table 3b).

PRODUCTION, INVENTORY AND USE

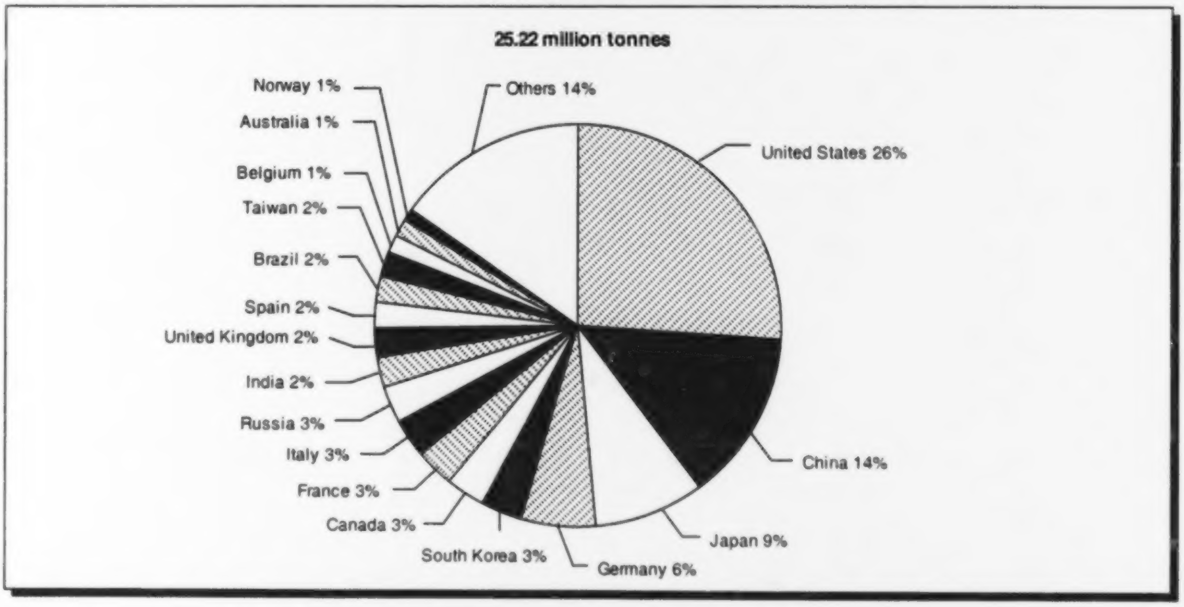
World production of primary aluminum increased to 24.6 Mt in 2000, up from 23.7 Mt in 1999 (refer to

Figure 4
Recycling of Aluminum in Canada, 1988-2000



Source: Natural Resources Canada, Annual Survey of Aluminum Metal Use in Canadian Establishments.
^{f} Forecast.
Notes: Export figures are obtained from Canadian government trade data. Data on metal use are obtained from responses to questionnaires sent to aluminum-using companies. In 2000, over 178 Canadian companies used primary, recycled and scrap aluminum. Companies surveyed include primary metal producing, recycling, casting, rolling, extruding and foundry operations.

Figure 5
Major Aluminum-Using Nations, Total Apparent Use of Primary Aluminum, 2000



Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.

Table 8). World production in 2001 is estimated to have fallen by about 0.5% to 24.5 Mt. The International Consultative Group on Nonferrous Metal Statistics reported that total world use of primary aluminum was 25.2 Mt in 2000, about 7% higher than the revised figure of 23.7 Mt in 1999 (Table 9).

Among International Aluminium Institute (IAI) members, the primary aluminum production rate decreased 3.9% during the year to 56 100 t/d in December 2001 from 58 400 t/d in December 2000. The average production rate for all of 2001 was 56 300 t/d, compared with an average of 57 900 t/d in 2000 (a decrease of 2.7%), although, early in 2002, daily rates were again above 57 000 t/d. Members' aluminum production capacity increased from 22.299 Mt/y at the end of 2000 to 22.976 Mt/y in 2001. On a longer term basis, the average daily production rate has been growing at about 2% per year since 1980 (Figure 2). (The IAI has an Internet site at www.world-aluminium.org.)

IAI inventories of unwrought aluminum peaked in January 2001 at 1.9 Mt, up from the 1.8 Mt recorded at the end of December 2000 and, following that peak, generally declined throughout the year to reach 1.7 Mt at the end of December 2001.

IAI total inventories started the year at 3.0 Mt, peaked in May at 3.2 Mt, and then gradually fell to end the year at 3.0 Mt. On the other hand, LME primary aluminum inventories increased from their December 2000 level of 322 000 t to end the year in December 2001 at 821 000 t. Similarly, aluminum alloy stocks in LME warehouses in January 2001 were approximately 86 000 t and they increased during the year to 121 000 t in December.

The IAI also reported that members' alumina production capacity increased from a revised 51.424 Mt/y in December 2000 to 52.981 Mt/y in December 2001, while alumina production also rose from 48.1 Mt in 2000 to 48.5 Mt in 2001.

WBMS reported that the use of primary aluminum in 2001 was 23.8 Mt. Asia was the region in the world with the largest aluminum use, accounting for 36% of total world refined aluminum use. Europe accounts for 32% and North America accounts for 25%.

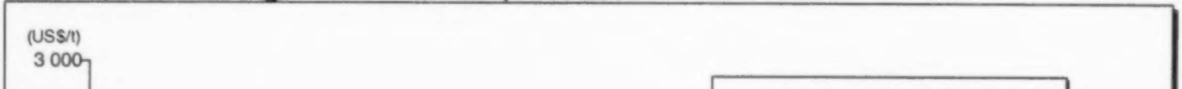
PRICES AND OUTLOOK

Primary-grade aluminum has established a longer term price range of between approximately US$1200 and $1800/t (US55¢ and 82¢/lb) over the last seven years. Cash settlement prices have generally trended downward from a peak above US$1700/t in early 2001. As a result of this short-term trend, the 2001 average of US$1444/t (US66¢/lb) was lower than the 2000 average of US$1555/t (US71¢/lb).

Aluminum alloy daily settlement prices on the LME reflected the general trend of primary aluminum prices. Aluminum alloy settlement prices started 2001 at US$1145/t (US52¢/lb) and have traded in a declining range from a peak of US$1290/t (US59¢/lb) established in February to US$1063/t (US48¢/lb) at the end of the year. For 2001, alloy prices averaged approximately US$1174/t (US53.3¢/lb) compared to an average of approximately US$1218/t (US55.3¢/lb in 2000).

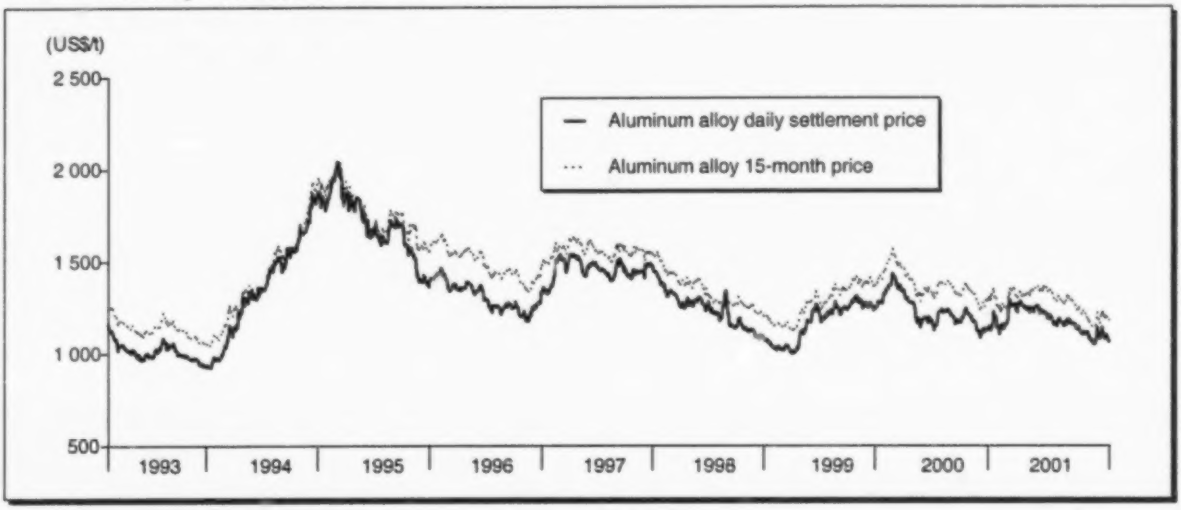
Production decreases in the Americas in 2000 and 2001 were generally offset by inventories and

Figure 6
London Metal Exchange Aluminum Prices, 1989-2001



Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

Figure 7
Aluminum Alloy Prices, London Metal Exchange, 1993-2001



Sources: Natural Resources Canada; London Metal Exchange; Reuters; Metalprices.com.

decreased demand in 2001. Although prices have strengthened in early 2002, given the increases in production capacity planned over the next three years and the potential for currently idled capacity to re-open, it is likely that prices will remain in the lower part of this long-term range in the near to medium term. As a result, the average price during 2002 is likely to fall from last year's price to US$1300-$1350/t (US59¢-62¢/lb).

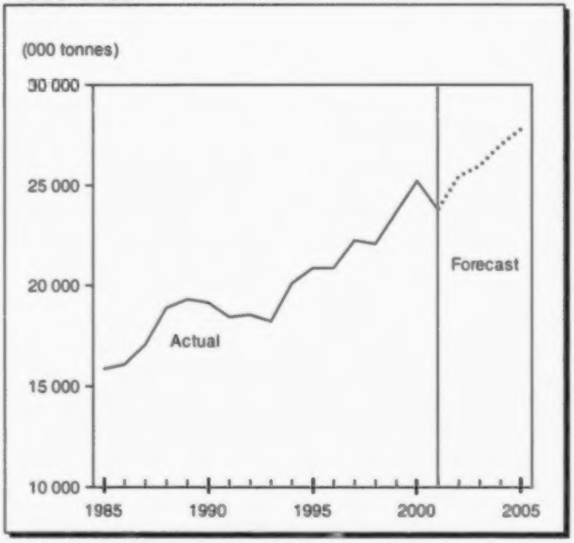
For 2002, world production of primary aluminum is expected to increase between 2 and 4% to about 25.2 Mt, consistent with aluminum's long-term growth rate over the last 20 years. The transportation and packaging markets are expected to lead the increase in demand for aluminum to the year 2005 and perhaps beyond.

IAI figures show that the world primary production capacity of its members is expected to increase about 1.4% to 23.3 Mt in December 2002 from 23.0 Mt at the end of 2001, with a slightly higher increase (2.7%) in 2003. Taking into account projected increases from non-IAI members, world primary production is expected to rise approximately 4% in 2002.

For alumina, IAI figures show that the alumina production capacity of its members is expected to increase from 53.0 Mt/y in December 2001 to 53.5 Mt/y in December 2002.

Canadian installed capacity for the production of primary aluminum is now above 2.7 Mt/y with the completion of Alcan's new smelter at Alma. With the

Figure 8
World Primary Aluminum Demand, 1985-2005



Sources: Natural Resources Canada, World Nonferrous Metal Statistics Group.

announced expansions at Alouette and modernization at Baie Comeau, Canadian production rates will further increase to above 3.0 Mt/y in 2005. Studies are under way on several other brownfield expansions and greenfield smelters.

Notes: (1) Information in this review was current as of March 31, 2002. (2) Lorraine Ralph of the Minerals and Mining Statistics Division prepared Tables 3a and 3b and she and others in that Division have provided assistance in generating the summary tables on Canadian aluminum. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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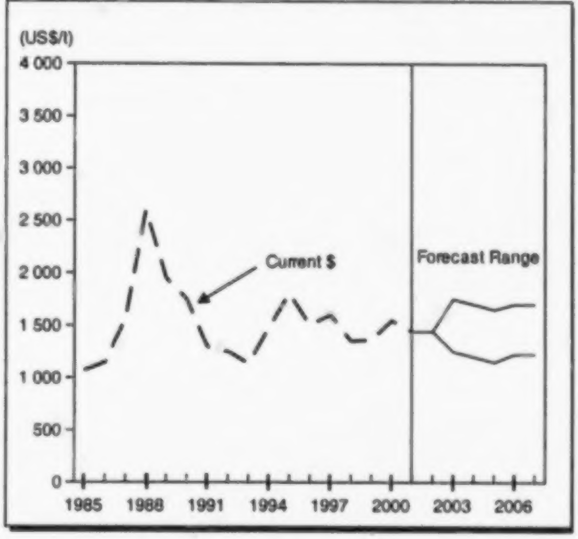
Figure 9
Aluminum Settlement Prices, 1985-2006



Source: Natural Resources Canada.

TABLE 1. CANADIAN ALUMINUM PRODUCED AND TRADED, 2000 AND 2001

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION		2 373 460	. .	2 582 746	. .
IMPORTS					
2606.00	Aluminum ores and concentrates				
	Brazil	1 293 334	43 403	1 496 401	56 860
	Guinea	499 469	20 079	478 332	23 511
	Ghana	–	–	281 805	10 594
	Guyana	244 871	8 747	222 501	8 343
	United States	(r) 187 737	(r) 11 316	67 958	5 210
	India	84 897	3 005	68 649	3 320
	Gambia	–	–	61 100	3 219
	Australia	322 257	12 962	79 648	2 820
	China	24 216	2 482	25 665	2 615
	Bermuda	163 096	5 166	67 000	1 451
	Other countries	18 718	823	12 590	810
	Total	(r) 2 838 595	(r) 107 983	2 861 649	118 753
2620.40	Ash and residues containing mainly aluminum	4 213	4 144	5 747	5 013
2818.20	Aluminum oxide (excluding artificial corundum)				
	Australia	1 790 055	497 325	1 671 455	479 161
	United States	(r) 1 205 184	(r) 392 977	1 202 126	383 465
	Jamaica	579 176	159 363	1 019 870	286 859
	Venezuela	25 315	7 106	51 921	14 688
	China	(r) 12 682	(r) 5 209	11 356	7 124
	Germany	(r) 1 871	(r) 3 849	2 138	4 215
	Guinea	12 941	2 442	3 801	3 258
	Austria	1 339	2 966	2 254	2 316
	France	819	1 374	1 524	1 866
	Other countries	106 635	31 588	4 529	2 875
	Total	(r) 3 736 017	(r) 1 104 199	3 970 974	1 185 827
2818.30	Aluminum hydroxide	8 233	6 818	5 474	7 289
7601.10	Unwrought aluminum, not alloyed				
	United States	(r) 42 780	(r) 100 616	20 995	47 522
	United Arab Emirates	304	743	191	530
	Argentina	1 304	3 516	98	346
	Other countries	870	1 555	211	469
	Total	(r) 45 258	(r) 106 430	21 495	48 867
7601.20	Unwrought aluminum, alloyed				
	United States	(r) 215 964	(r) 377 272	192 126	337 198
	Russia	12 113	21 281	5 245	10 305
	United Arab Emirates	954	2 382	1 313	3 395
	Japan	3	5	899	2 002
	United Kingdom	(r) 412	(r) 977	647	1 402
	Australia	883	2 373	397	979
	Other countries	1 395	3 301	865	2 027
	Total	(r) 231 724	(r) 407 591	201 492	357 308
7602.00	Aluminum waste and scrap	(r) 127 635	(r) 182 972	114 388	159 385
76.03	Aluminum powders and flakes	(r) 2 124	(r) 8 693	2 070	8 591

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
76.04	Aluminum bars, rods and profiles				
7604.10	Of aluminum, not alloyed				
	United States	12 028	47 239	4 597	25 413
	Belgium	829	3 912	772	4 097
	Canada	166	1 058	209	1 416
	Austria	692	2 797	343	1 335
	Other countries	2 116	6 470	610	2 713
	Total	15 831	61 476	6 531	34 974
7604.21 to	Of aluminum alloys				
7604.29	United States	(r) 30 311	(r) 145 850	25 921	131 964
	China	3 759	(r) 12 925	5 216	19 530
	South Korea	890	3 313	1 847	6 481
	United Kingdom	172	1 279	280	1 976
	Germany	(r) 246	(r) 1 680	253	1 864
	France	(r) 446	(r) 2 377	312	1 648
	Other countries	749	3 859	803	4 449
	Total	(r) 36 573	(r) 171 283	34 632	167 912
76.05	Aluminum wire	(r) 7 986	(r) 35 067	8 466	33 689
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	(r) 483 433	(r) 1 731 718	444 034	1 595 150
76.07	Aluminum foil not exceeding 0.2 mm	(r) 43 857	(r) 217 366	48 484	237 124
76.08	Aluminum tubes and pipes	(r) 12 663	(r) 62 075	12 261	62 338
76.09	Aluminum tube or pipe fittings	(r) 7 825	(r) 53 861	9 102	61 097
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	(r) 92 240	. .	108 129
		(number)		**(number)**	
76.11	Aluminum reservoirs, tanks, vats and similar containers, for any material, of a capacity exceeding 300 litres	(r) 3 679	(r) 34 860	2 299	35 375
76.12	Aluminum casks, drums, cans, boxes and similar containers, for any material, of a capacity not exceeding 300 litres	(r) 815 774 291	(r) 165 936	1 104 194 444	192 260
76.13	Aluminum containers for compressed or liquefied gas	(r) 99 304	(r) 15 231	99 860	10 150
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	(r) 182	(r) 776	632	2 392
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	(r) 93 696	. .	89 254

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
76.16	Other articles of aluminum	. .	(r) 267 950	. .	287 889
EXPORTS					
2606.00	Aluminum ores and concentrates				
	United States	100	15	20	14
	Cuba	–	–	6	5
	Switzerland	141	60	–	–
	Greece	6	5	–	–
	Total	247	80	26	19
2818.20	Aluminum oxide (excluding artificial corundum)				
	United States	60 991	50 811	47 223	43 584
	Other countries	(r) 249	(r) 539	1 346	2 290
	Total	(r) 61 240	(r) 51 350	48 569	45 874
7601.10	Unwrought aluminum, not alloyed				
	United States	556 959	1 315 008	934 369	2 169 645
	Netherlands	115 289	243 790	133 784	283 027
	South Korea	35 278	87 971	40 417	103 001
	France	22 260	44 380	24 817	51 864
	Japan	32 819	67 061	22 357	46 413
	Mexico	28 607	70 225	10 677	24 832
	Other countries	13 705	32 012	5 536	14 107
	Total	804 917	1 860 447	1 171 957	2 692 889
7601.20	Unwrought aluminum alloys				
	United States	(r) 882 032	(r) 2 306 876	756 106	1 935 398
	Japan	109 563	249 559	86 628	201 615
	South Korea	27 477	72 351	18 207	47 465
	United Kingdom	4 713	13 738	5 629	16 104
	Netherlands	3 265	8 301	3 629	9 470
	Ireland	1 932	5 792	1 379	3 897
	Israel	1 452	4 133	1 081	2 686
	Other countries	1 778	5 790	892	2 402
	Total	(r) 1 032 212	(r) 2 666 540	873 551	2 219 037
7602.00	Aluminum waste and scrap				
	United States	(r) 274 239	(r) 494 299	267 538	467 924
	Japan	4 106	9 208	6 476	14 817
	China	8 404	11 893	9 147	13 101
	Netherlands	1 268	3 076	635	1 609
	Taiwan	339	395	1 279	1 550
	South Korea	592	836	744	1 081
	Other countries	1 173	2 139	1 773	1 722
	Total	(r) 290 121	(r) 521 846	287 592	501 804

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
76.03	Aluminum powders and flakes	(r) 1 672	(r) 3 170	843	1 858
76.04	Aluminum bars, rods and profiles	(r) 81 824	(r) 391 061	73 532	358 819
76.05	Aluminum wire	90 031	257 079	86 428	229 337
76.06	Aluminum plates, sheets and strip, of a thickness exceeding 0.2 mm	(r) 345 805	(r) 1 116 698	327 252	1 044 288
76.07	Aluminum foil not exceeding 0.2 mm	(r) 41 307	(r) 206 398	41 986	223 092
76.08	Aluminum tubes and pipes	(r) 7 495	(r) 40 926	5 484	30 254
76.09	Aluminum tube or pipe fittings	. .	(r) 12 510	. .	11 445
76.10	Aluminum structures and parts of structures, aluminum plates, rods, profiles, tubes and the like, prepared for use in structures	. .	(r) 337 923	. .	346 306
		(number)		**(number)**	
7611.00	Aluminum reservoirs, tanks, vats and similar containers, for any material, of a capacity exceeding 300 litres	(r) 17 905	(r) 1 078	230	1 613
7613.00	Aluminum containers for compressed or liquefied gas	761 141	5 793	730 529	3 677
		(tonnes)		**(tonnes)**	
76.14	Stranded wire, cables, plaited bands and the like, of aluminum, not electrically insulated	(r) 11 326	(r) 36 187	9 826	36 224
76.15	Table, kitchen or other household articles and parts thereof, of aluminum	. .	(r) 68 333	. .	71 326
76.16	Other articles of aluminum	. .	194 287	. .	199 799

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, ALUMINUM SMELTER CAPACITY

Company	As of December 31, 2001
	(t/y)
Alcan Aluminium Inc.	
Quebec	
Grande-Baie	196 000
Arvida, Jonquière	248 000
Alma	400 000
Shawinigan	91 000
Beauharnois	50 000
Laterrière	219 000
British Columbia	
Kitimat	275 000
Alcoa Inc.	
Quebec	
Baie-Comeau	
Aluminerie de Baie-Comeau	418 000
Deschambault	
Aluminerie Lauralco Inc.	240 000
Aluminerie de Bécancour Inc.	
Quebec	
Bécancour	390 000
Alcoa, 74.95%	
Pechiney, 25.05%	
Aluminerie Alouette Inc.	
Quebec	244 000
Sept-Îles	
Société Générale de Financement du Québec, 20% (1)	
Aluminium Austria Metall Québec, 20%	
Corus Aluminium Québec Inc., 20% (2)	
Hydro Aluminium, 20%	
Kobe Aluminium Canada Inc., 13.33% (3)	
Marubeni Québec Inc., 6.66%	
Total Canadian capacity	2 771 000

Source: Natural Resources Canada.
(1) This interest was subsequently purchased by Alcan. (2) Alcan and Corus have subsequently agreed on Alcan's purchase of this interest. (3) This interest was subsequently purchased by Société Générale de Financement du Québec.

TABLE 3a. USE(1) OF ALUMINUM METAL(4) IN CANADA AT FIRST PROCESSING STAGE, 1998-2000

	1998 (r,a)	1999 (r,a)	2000 (r,a,5)
		(tonnes)	
METAL USED IN CASTINGS (6)			
Permanent mould	128 966	129 574	132 891
Sand	3 262	4 442	4 460
Die and other	166 763	205 781	205 031
Total	298 991	339 797	342 383
METAL USED IN WROUGHT PRODUCTS			
Sheet, plate, coil and foil	208 563	229 139	239 126
Extrusions, including tubing	188 610	234 843	230 063
Other wrought products (including rods, forgings and slugs)	149 451	153 936	162 865
Total	546 624	617 918	632 054
METAL USED IN OTHER PRODUCTS			
Destructive uses (deoxidizer), non-aluminum base alloys, powder and paste and other uses	44 358	41 526	41 204
Total used	889 973	999 242	1 015 640
Aluminum metal used for the production of recycled aluminum (2)	147 847	145 959	159 419

	Metal Entering Plant			On Hand at December 31		
	1998	1999	2000 (r)	1998	1999	2000 (r)
Primary aluminum and alloys	663 468	733 569	735 641	17 630	21 340	17 835
Recycled aluminum	159 234	198 370	191 326	5 995	5 415	6 672
Scrap originating outside plant	248 068	253 985	279 190	8 206	13 833	13 971
Total	1 070 770	1 185 925	1 206 157	31 831	40 588	38 479
Aluminum shipments (3)				31 001	33 674	34 525

Source: Natural Resources Canada.
(r) Revised.
(a) Increase in number of companies being surveyed; therefore, the closing inventory of the previous year does not equal the opening inventory of the current year.
(1) Available data as reported by users. (2) Aluminum metal used in the production of recycled aluminum is not included in usage totals. (3) Aluminum metal shipped without change. Does not refer to shipments of goods of own manufacture. (4) Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap. (5) For 2000 this table is compiled from Natural Resources Canada's annual survey, "Use of Aluminum Metal" from data for 178 Canadian users.
(6) Metal reported used in casting may contain runaround scrap.
Note: Numbers may not add to totals due to rounding.

TABLE 3b. USE(1) OF ALUMINUM METAL(2) IN CANADA, BY TYPE AT FIRST PROCESSING STAGE, 1988-2000

	1988 (a)	1989 (a)	1990 (a)	1991 (a)	1992 (a)	1993 (a)	1994 (a)	1995	1996 (a)	1997 (a)	1998 (a)	1999 (a)	2000 (r,a,4)
							(tonnes)						
TYPE OF ALUMINUM METAL USED IN PRODUCTS OTHER THAN RECYCLED ALNUMINUM													
Primary aluminum and alloys	381 106	393 027	351 877	355 010	369 185	447 997	485 845	490 000	512 865	558 139	653 320	719 124	725 320
Purchased recycled aluminum	70 633	75 031	82 763	73 461	87 896	95 774	117 710	114 961	119 515	138 852	158 355	199 429	190 026
Outside aluminum scrap	28 039	27 306	18 617	17 768	24 009	25 084	31 469	30 441	44 555	67 447	78 298	80 689	100 294
Total used in products other than in recycled aluminum	479 779	495 363	453 257	446 239	481 089	568 854	635 024	635 402	676 935	764 438	889 973	999 242	1 015 640
TYPE OF ALUMINUM METAL USED IN RECYCLED ALUMINUM (3)													
Primary aluminum and alloys	13 307	22 383	x	x	x	x	x	x	x	14 650	x	10 879	13 765
Outside aluminum scrap	94 308	79 716	x	x	x	x	x	x	x	113 865	x	135 081	145 654
Total used in recycled aluminum (3)	107 615	102 098	115 112	101 503	127 818	131 174	145 661	146 987	81 629	128 515	147 847	145 959	159 419

Source: Natural Resources Canada.
(r) Revised; x Confidential.
(a) Increase in number of companies being surveyed.
(1) Available data as reported by users. (2) Aluminum metal refers to primary aluminum and alloys, purchased recycled aluminum, and outside aluminum scrap. (3) Aluminum metal used in recycled aluminum is not included in "Total used in products other than in recycled aluminum" above. (4) For 2000 this table is compiled from Natural Resources Canada's annual survey, "Consumption of Aluminum Metal" from data for 178 Canadian users.
Note: Numbers may not add to totals due to rounding.

TABLE 4. AVERAGE ALUMINUM PRICES

Year	Month	LME Cash Settlement (1)	*Metals Week* U.S. Markets (1)
		(US$/t)	(US¢/lb)
ANNUAL AVERAGES (2)			
1990		1751.80	75.0
1991		1302.70	59.5
1992		1254.60	57.5
1993		1139.40	53.3
1994		1477.20	71.2
1995		1806.10	85.9
1996		1506.00	71.3
1997		1599.70	77.1
1998		1357.80	65.6
1999		1361.09	65.7
2000		1549.14	74.6
2001		1443.63	68.8
MONTHLY AVERAGES			
1999	January	1680.70	80.1
	February	1670.67	80.3
	March	1577.41	76.2
	April	1457.61	70.6
	May	1467.19	70.9
	June	1506.73	72.7
	July	1563.88	76.3
	August	1528.02	74.4
	September	1601.60	77.2
	October	1500.66	72.3
	November	1474.23	70.1
	December	1565.87	74.3
2000	January	1615.65	75.2
	February	1604.36	76.4
	March	1509.17	72.4
	April	1496.91	71.3
	May	1538.77	72.7
	June	1466.13	69.7
	July	1416.39	68.1
	August	1377.08	66.1
	September	1344.56	64.9
	October	1282.50	62.1
	November	1327.46	63.4
	December	1344.63	64.1

Sources: Natural Resources Canada; *Metals Week.*

(1) Highest grade sold. (2) Primary ingots, minimum 99.7% purity; prior to October 1988, minimum 99.5% purity.

TABLE 5 - AVERAGE ALUMINUM ALLOY (RECYCLED) PRICES

Year	Month	LME Alloy (1) Cash Settlement	
		(US$/t)	(US$/lb)
ANNUAL AVERAGES			
1993		1 005.2	0.46
1994		1 452.9	0.66
1995		1 656.0	0.75
1996		1 302.8	0.59
1997		1 461.0	0.66
1998		1 203.8	0.55
1999		1 191.2	0.54
2000		1 216.9	0.55
2001		1 172.1	0.53
MONTHLY AVERAGES			
2000	January	1 387.4	0.63
	February	1 345.8	0.61
	March	1 273.9	0.58
	April	1 171.4	0.53
	May	1 181.3	0.54
	June	1 190.7	0.54
	July	1 223.5	0.55
	August	1 176.7	0.53
	September	1 212.4	0.55
	October	1 143.6	0.52
	November	1 128.5	0.51
	December	1 167.5	0.53
2001	January	1 150.3	0.52
	February	1 258.6	0.57
	March	1 258.0	0.57
	April	1 239.6	0.56
	May	1 233.3	0.56
	June	1 194.2	0.54
	July	1 164.8	0.53
	August	1 164.6	0.53
	September	1 131.9	0.51
	October	1 095.4	0.50
	November	1 087.5	0.49
	December	1 087.4	0.49

Sources: Natural Resources Canada; *Metals Week*.
(1) Alloy ingots, meeting LME specifications.

TABLE 6. WORLD MINE PRODUCTION OF BAUXITE, 1996-2000

	World Rank in 2000	1996	1997	1998	1999	2000 (p)
				(000 tonnes)		
Australia	1	43 063.0	44 465.0	44 553.0	(r) 48 416.0	53 802.0
Guinea	2	18 282.0	19 250.0	17 000.0	(r) 17 320.0	17 950.0
Brazil	3	11 060.1	11 162.8	11 961.1	13 838.8	13 224.1
Jamaica	4	11 828.6	11 987.3	12 646.4	11 688.5	11 126.5
China	5	8 878.8	9 000.0	(r) 6 400.0	(r) 7 100.0	7 900.0
India	6	5 757.5	5 800.3	5 980.1	6 712.2	7 389.9
Venezuela	7	(r) 4 834.1	(r) 4 966.8	4 825.6	(r) 4 166.5	4 360.7
Russia	8	3 928.0	3 991.0	3 488.4	3 500.0	4 000.0
Kazakhstan	9	3 345.9	3 416.0	3 436.8	3 606.5	3 729.6
Suriname	10	3 702.5	3 877.2	3 889.6	3 714.6	3 610.4
Guyana	11	2 475.5	(r) 2 467.3	(r) 2 266.7	2 359.3	2 689.5
Greece	12	2 451.7	1 876.6	1 823.0	1 882.5	1 990.5
Indonesia	13	842.0	808.7	1 055.6	1 116.3	1 150.8
Hungary	14	1 055.8	742.6	(r) 1 138.8	(r) 941.0	1 046.5
Yugoslavia Fed.	15	323.0	470.0	226.0	500.0	630.0
Turkey	16	544.5	369.5	458.0	207.7	458.5
Iran	17	(r) 230.4	(r) 245.0	(r) 336.0	(r) 912.5	448.8
Ghana	18	473.2	519.2	442.5	353.1	424.6
United States	19	(r) 200.0	(r) 200.0	(r) 200.0	(r) 200.0	200.0
France	20	165.0	(r) 169.0	(r) 170.0	(r) 170.0	185.0
Malaysia	21	218.7	279.1	160.3	(r) 223.7	123.3
Vietnam	22	30.0	30.0	30.0	30.0	30.0
Pakistan	23	4.1	4.9	5.0	(r) 11.2	8.7
Mozambique	24	11.5	8.2	6.1	7.9	8.1
Albania	25	(r) 3.4	(r) 4.5	(r) 4.1	(r) 4.6	3.0
Romania		175.2	127.5	161.9	–	–
Dominican Republic		–	–	–	–	–
Italy		–	–	–	–	–
Sierra Leone		–	–	–	–	–
Total world		(r) 123 884.5	(r) 126 238.5	(r) 122 665	(r) 128 982.9	136 490.5
% change from previous year		4.8	1.9	-2.8	5.2	5.8

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics.
– Nil; (p) Preliminary; (r) Revised.

TABLE 7. PRODUCTION OF ALUMINA (HYDRATE) 1996-2001

	World Rank in 2001	1996	1997	1998	1999	2000	2001 (e)
				(000 tonnes)			
Australia	1	13 349.0	13 385.0	13 853.0	(r) 14 532.0	15 715.0	16 346.0
United States (3)	2	4 700.0	5 093.0	(r) 5 654.0	(r) 5 144.0	4 782.0	4 775.0
China	3	2 490.0	2 922.8	(r) 3 340.0	(r) 3 822.0	4 290.0	4 660.0
Brazil	4	2 759.0	3 088.0	3 322.1	3 515.1	3 754.0	3 800.0
Jamaica	5	3 199.5	3 394.2	3 440.2	3 569.6	3 600.1	3 600.0
Russia	6	2 148.0	2 379.8	2 465.4	2 657.1	2 889.0	3 000.0
India	7	1 706.0	1 940.0	1 855.0	1 930.0	2 107.0	2 200.0
Suriname	8	1 642.9	1 725.9	1 771.9	1 853.1	1 906.1	1 900.0
Venezuela	9	1 775.0	1 730.4	1 553.4	(r) 1 468.5	1 755.3	1 800.0
Ireland	10	(r) 1 290.0	(r) 1 350.0	(r) 1 410.0	(r) 1 450.0	1 500.0	1 500.0
Ukraine	11	1 159.5	1 074.5	1 290.7	1 230.2	1 360.0	1 400.0
Kazakhstan	12	1 083.4	1 094.2	1 084.5	1 157.7	1 216.6	1 250.0
Canada (2)	13	1 060.0	1 165.0	1 229.0	1 233.0	1 197.4	1 200.0
Spain	14	1 094.8	1 110.3	1 110.0	1 112.0	1 123.0	1 125.0
Italy	15	881.0	914.0	935.0	973.0	1 022.0	1 050.0
Germany	16	792.0	850.0	778.3	(r) 806.0	826.0	830.0
Japan	17	718.9	728.0	737.6	736.6	781.7	780.0
Greece	18	619.8	615.7	649.4	633.0	690.0	700.0
France	19	542.0	589.0	520.0	556.0	600.0	600.0
Guinea	20	622.0	527.0	(r) 500.0	569.0	541.0	550.0
Romania (1)	21	258.5	279.5	(r) 250.2	277.4	416.6	250.0
Azerbaijan	22	–	–	–	(r) 77.0	217.2	220.0
Hungary	23	358.7	350.0	160.0	200.0	200.0	200.0
Yugoslavia	24	105.0	159.5	152.6	156.0	186.1	185.0
Turkey	25	159.3	164.3	156.8	159.1	155.4	155.0
United Kingdom	26	99.0	100.0	(r) 115.0	(r) 94.0	89.0	90.0
Slovakia		56.0	46.8	–	–	–	–
South Korea		100.0	70.0	–	–	–	–
Total world		(r) 44 769.3	(r) 46 846.9	(r) 48 334.1	(r) 49 911.4	52 920.5	54 166.0
% change from previous year		3.3	4.6	3.2	3.3	6.0	2.4

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics, International Aluminium Association; media reports.

– Nil; (r) Revised.

(1) Calcined. (2) Alumina equivalent. (3) Calcined equivalent.

TABLE 8. WORLD PRODUCTION OF PRIMARY ALUMINUM, 1996-2002

	World Rank in 2000	World Rank in 2001	1996	1997	1998	1999	2000	2001 (e)	2002 (f)
						(000 tonnes)			
China	3	1	1 770.9	2 035.0	2 335.7	2 598.5	2 989.0	3 420.0	4 020.0
Russia	2	2	2 871.6	2 906.0	(r) 3 010.0	(r) 3 149.0	3 247.0	3 300.0	3 350.0
United States	1	3	3 577.2	3 603.4	3 712.7	3 778.6	3 668.4	2 637.0	2 800.0
Canada	4	4	2 283.2	2 327.2	2 374.1	2 389.8	2 373.5	2 582.7	2 700.0
Australia	5	5	1 370.3	1 490.1	1 626.2	1 719.3	1 761.5	1 775.0	1 790.0
Brazil	6	6	1 197.4	1 189.1	1 208.0	1 249.6	1 277.4	1 130.0	1 250.0
Norway	7	7	862.3	918.6	994.2	1 009.0	1 031.1	1 070.0	1 070.0
South Africa	8	8	617.0	682.9	692.5	686.9	671.0	659.0	680.0
Germany	10	9	576.5	571.9	612.4	633.8	643.5	650.0	660.0
India	9	10	530.6	544.9	(r) 542.0	(r) 594.0	646.3	625.0	625.0
Venezuela	11	11	634.9	640.8	586.5	(r) 570.4	570.4	575.0	580.0
Dubai	12	12	258.5	(r) 379.2	386.6	(r) 440.7	536.0	550.0	560.0
Bahrain	13	13	464.5	489.9	501.3	(r) 502.7	509.0	515.0	525.0
France	14	14	380.1	399.4	423.6	455.1	441.2	460.0	465.0
Spain	15	15	361.8	359.9	360.4	363.9	365.7	375.0	380.0
United Kingdom	17	16	240.0	247.7	258.4	(r) 272.2	305.1	335.0	345.0
New Zealand	16	17	284.5	310.3	317.4	326.7	329.2	330.0	335.0
Tajikistan	19	18	198.3	188.9	195.6	229.1	271.1	320.0	330.0
Netherlands	18	19	227.0	231.8	(r) 264.7	287.4	301.7	300.0	300.0
Argentina	20	20	183.9	187.2	186.7	206.4	261.8	250.0	265.0
Mozambique	37	21	–	–	–	–	64.0	250.0	260.0
Iceland	21	22	103.4	122.9	173.4	221.5	225.7	240.0	250.0
Indonesia	22	23	223.1	219.4	133.4	111.7	190.5	210.0	220.0
Italy	23	24	184.4	187.7	187.0	(r) 187.2	189.2	190.0	190.0
Egypt	24	25	179.2	178.2	187.2	186.7	188.9	190.0	190.0
Romania	25	26	140.9	161.9	174.0	(r) 174.1	179.0	180.0	180.0
Greece	26	27	130.9	132.6	146.1	159.9	162.6	165.0	165.0
Ghana	27	28	137.0	151.6	56.1	114.2	155.5	160.0	130.0
Iran	28	29	80.1	92.3	(r) 123.8	(r) 137.4	139.5	150.0	150.0
Slovakia	29	30	111.5	110.2	108.0	109.2	109.8	110.0	110.0
Ukraine	30	31	89.9	100.5	106.7	112.4	103.6	105.0	105.0
Sweden	31	32	98.3	98.4	95.7	98.5	100.1	100.0	100.0
Cameroon	32	33	82.3	90.9	81.6	91.9	94.9	95.0	95.0
Bosnia	33	34	–	8.0	30.0	70.0	94.5	95.0	95.0
Yugoslavia	34	35	37.4	65.7	60.1	72.5	88.2	95.0	95.0
Slovenia	35	36	65.8	74.4	70.8	77.2	83.8	85.0	85.0
Mexico	36	37	61.5	66.4	61.8	62.7	65.0	60.0	60.0
Turkey	38	38	62.1	62.0	61.8	61.7	61.5	60.0	60.0
Poland	39	39	51.5	51.5	51.5	(r) 51.6	52.3	50.0	50.0
Switzerland	40	40	26.6	27.3	32.1	34.4	35.5	35.0	35.0
Hungary	41	41	33.5	32.5	33.7	33.6	33.9	35.0	35.0
Japan	42	42	17.0	16.7	16.3	10.9	6.5	7.0	7.0
Suriname			26.0	23.1	27.1	6.6	–	–	–
Nigeria			–	2.5	25.5	15.9	–	–	–
Total world			20 832.9	(r) 21 780.9	(r) 22 632.7	(r) 23 664.9	24 624.4	24 525.7	25 500.0
% change from previous year			5.5	4.6	3.9	4.6	4.1	-0.4	4.0

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; World Bureau of Metal Statistics; International Aluminium Institute; media reports.

– Nil; (e) Estimated; (f) Forecast; (r) Revised.

TABLE 9. APPARENT USE OF PRIMARY ALUMINUM, 1996-2000

	World Rank in 2000	1996	1997	1998	1999	2000
				(000 tonnes)		
United States	1	5 500.0	5 800.0	6 100.0	6 500.0	6 565.0
China (1)	2	2 142.0	(r) 2 289.0	2 421.0	(r) 2 914.0	3 450.0
Japan	3	(r) 2 386.1	(r) 2 433.5	(r) 2 082.0	(r) 2 112.3	2 222.7
Germany	4	1 355.0	1 558.0	(r) 1 520.0	(r) 1 446.0	1 498.0
South Korea	5	674.3	666.3	505.7	813.9	822.9
Canada	6	(r) 614.3	(r) 643.5	720.6	(r) 777.2	798.7
France	7	671.7	724.2	733.8	(r) 774.2	780.4
Italy	8	614.0	671.0	674.0	(r) 734.6	779.7
Russia	9	444.7	469.7	489.2	(r) 567.1	748.4
India	10	584.8	(r) 553.4	(r) 566.5	(r) 569.5	602.4
United Kingdom	11	571.0	583.0	579.0	581.0	588.0
Spain	12	360.0	430.0	435.5	494.0	525.6
Brazil	13	497.0	478.6	521.4	463.1	519.8
Taiwan	14	310.3	374.3	300.7	464.1	501.6
Belgium	15	331.0	345.0	370.0	350.0	360.0
Australia	16	321.8	352.0	(r) 370.3	(r) 344.4	350.5
Norway	17	169.0	197.0	155.0	(r) 217.0	247.0
Bahrain	18	(r) 219.0	(r) 233	(r) 238.0	(r) 239.0	234.2
Greece	19	156.4	203.8	212.7	212.5	233.1
Turkey	20	136.0	(r) 160.8	180.7	169.4	211.2
Hungary	21	158.6	183.4	(r) 163.7	(r) 171.3	210.1
Thailand	22	220.2	232.8	(r) 128.4	155.3	195.2
South Africa	23	101.0	124.4	142.8	125.0	175.0
Austria	24	155.0	162.0	(r) 159.8	(r) 142.6	168.2
Switzerland	25	140.2	144.0	(r) 165.9	157.0	156.1
Netherlands	26	(r) 145.0	(r) 155.0	(r) 155	(r) 155.0	155.0
Poland	27	(r) 87.9	(r) 101.5	(r) 107.8	(r) 133.0	149.9
Sweden	28	129.0	142.0	177.0	132.2	147.0
Venezuela	29	206.9	193.4	179.7	121.8	146.2
Indonesia	30	(r) 161.2	203.0	75.4	138.7	145.8
Romania	31	35.7	(r) 70.6	87.7	(r) 113.6	125.7
Malaysia	32	(r) 115.3	(r) 147.8	(r) 64.7	(r) 130.6	115.0
Iran	33	106.0	104.9	(r) 101.1	(r) 105.0	104.8
Mexico	34	92.7	83.2	(r) 91.1	(r) 89.6	100.0
Slovenia	35	46.5	52.8	74.6	75.3	89.9
Egypt	36	79.2	97.9	91.6	82.7	81.8
Argentina	37	86.4	(r) 94.9	(r) 106.3	(r) 82.9	81.6
Portugal	38	58.1	75.4	68.3	82.0	78.0
Czech Republic	39	53.0	62.8	78.9	65.7	77.6
Ukraine	40	51.0	(r) 50.0	(r) 50.0	(r) 50.0	50.0
Israel	41	37.2	39.5	45.9	(r) 44.0	44.8
New Zealand	42	38.9	37.0	34.2	42.8	42.7
Denmark	43	27.0	36.0	38.9	39.4	41.2
Finland	44	30.4	33.1	(r) 36.2	37.1	38.5
Slovakia	45	(r) 4.7	(r) 4.6	22.2	(r) 33.9	36.3
Philippines	46	26.3	34.2	24.0	33.6	32.8
Colombia	47	35.3	42.8	36.3	27.4	31.8
Other Asia	48	35.0	35.0	35.0	35.0	30.0
Croatia	49	20.7	22.0	24.0	(r) 30.0	28.4
Other America	50	(r) 25.0	(r) 25	(r) 25	(r) 25.0	25.0
Saudi Arabia	51	25.0	25.0	25.0	25.0	25.0
Cameroon	52	18.0	24.7	24.9	22.0	24.8
Vietnam	53	(r) 6.3	(r) 8.4	(r) 15.6	(r) 16.9	21.1
Dubai	54	19.4	32.1	(r) 18.5	20.0	20.0
North Korea	55	20.0	20.0	20.0	(r) 20.0	20.0
Bangladesh	56	10.0	(r) 14.2	(r) 17.8	(r) 18.0	18.0

TABLE 9 (cont'd)

	World Rank in 2000	1996	1997	1998	1999	2000
				(000 tonnes)		
Ghana	57	16.1	16.0	16.0	16.0	16.0
Yugoslavia	58	17.3	23.7	19.2	13.1	16.0
Lebanon	59	10.0	17.0	(r) 20.9	(r) 14.2	15.0
Chile	60	13.9	15.5	(r) 10.6	(r) 11.2	14.6
Other Africa	61	9.9	12.0	10.0	12.0	12.0
Ireland	62	3.8	5.8	6.6	8.2	10.2
Pakistan	63	15.0	15.0	15.0	9.4	10.0
Belarus	64	–	7.4	9.1	9.0	9.0
Bulgaria	65	6.7	7.8	8.0	8.0	8.6
Nigeria	66	7.0	7.0	7.0	7.0	7.0
Singapore	67	40.0	15.0	33.5	(r) 4.3	4.1
Algeria	68	5.0	5.0	5.0	(r) 4.1	4.0
Morocco	69	1.6	2.0	3.4	(r) 3.5	3.5
Macedonia	70	2.8	2.0	3.0	3.0	3.0
Other Europe	71	–	2.0	1.5	2.0	3.0
Iceland	72	1.0	1.7	3.0	3.0	3.0
Tunisia	73	3.5	(r) 2.1	(r) 4.4	(r) 2.6	3.0
Kazakhstan	74	–	1.6	1.7	2.0	2.0
Peru	75	3.6	2.5	2.5	0.9	1.3
Albania	76	1.0	1.0	1.0	1.0	1.0
Cuba	77	1.0	1.0	1.0	1.0	1.0
Iraq	78	1.0	1.0	1.0	1.0	1.0
Hong Kong (1)		40.0	. .	. .	. .	. .
Total World		(r) 20 866.7	(r) 22 245.6	(r) 22 072.8	(r) 23 659.2	25 220.8
% change from previous year		0.0	6.6	-0.8	7.2	6.6

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
– Nil; . . Not available; (r) Revised.
(1) Starting in 1997, Hong Kong is included with China.

TABLE 10. ABBREVIATIONS OF COMPANY NAMES AND INSTITUTIONS USED IN THIS REPORT

Company	Abbreviation	Web Site Address
Alcan Inc.	Alcan	www.alcan.com
Alcoa Inc.	Alcoa	www.alcoa.com
Alcoa World Alumina and Chemicals	AWAC	www.alcoa.com
Alumina do Norte do Brasil S.A.	Alunorte	www.cvrd.com.br
Aluminerie Alouette Inc.	Alouette	www.alouette.com
Aluminerie de Bécancour Inc.	A.B.I.	www.alcoa.com
Aluminium Association of Canada	The Association	www.aia.aluminium.qc.ca
Aluminium Corp. of China	Chalco	. .
Alumina Partners of Jamaica	Alpart	www.kaiseral.com
Columbia Ventures Corporation	Columbia Ventures	www.nordural.is
Comalco Ltd.	Comalco	www.riotinto.com
CVG Alcasa	Alcasa	www.aluminio.com.ve
Dubai Aluminium Company Limited	Dubal	www.dubal.co.ae
Aluminum Company of Egypt	Egyptalum	www.egyptalum.com.eg
Elkem ASA	Elkem	www.elkem.com
Federation of Aluminium Consumers in Europe	FACE	www.facealuminium.com
International Aluminium Institute	IAI	www.world-aluminium.org
Jamaica Aluminium Co.	Jamalco	. .
KTD L.L.C.	KTD	www.ktdal.com
National Aluminium Company Limited	Nalco	www.nalcoindia.com
Norsk Hydro A.S.A / Hydro Aluminium a.s.	Norsk Hydro or Hydro Aluminium	www.hydro.com
Pechiney SA	Pechiney	www.aluminium-pechiney.com
Reydarál hf	Reydarál	. .
Sibirsky Aluminium	Sibirsky (Russian Aluminum)	www.sibirskyaluminum.com
The Aluminum Association Inc.	Aluminum Association	www.aluminum.org
Vietnam National Mineral Corp.	Vimico	. .

Source: Natural Resources Canada.
. . URL not available.

TABLE 11. BAUXITE AND ALUMINA PROJECTS

Country	Project/Company	Remarks	Near-Term Change (t/y)
Australia	Gladstone alumina refinery - Comalco	First stage of proposed A$1.4 billion refinery in central Queensland approved for construction. Requires expansion of the Weipa bauxite mine. Potential to increase capacity to 4 Mt/y.	1 400 000
	Gove alumina refinery	Alcan acquired bauxite mine and refinery. Expansion of refinery to 2 Mt/y from 1.8 Mt/y.	200 000
	Queensland Alumina Ltd. refinery	Proposal to expand capacity from 3.65 Mt/y to 4.35 Mt/y.	
	Wagerup - Alcoa/WMC	Decision pending on increase in capacity of refinery to 3.3 Mt/y.	
	Worsley	BHP Billiton increased ownership; expansion to 3.5 Mt/y expected by 2005.	
Azerbaijan	Sumgait Non-Ferrous Metals plant	Feasibility study into expansion of alumina refinery to 450 Mt/y in 2002.	
Brazil	Barcarena alumina refinery - Alunorte CVRD and Norsk Hydro.	Expansion under way from 1.5 to 2.3 Mt/y. Work to be completed in 2002, with full production in 2003. Feasibility study on further expansion to 5 Mt/y. Studies for a new bauxite mine to support additional expansions.	800 000
	Espirito Santo State Bauxite mine and refinery - Curimbaba	Company made public presentations on environmental and social impacts of a mine/1-Mt/y refinery project in Espirito Santo State. Expected to form a consortium to complete development of project.	
	Para State mine - CVRD	Potential new 5-Mt/y mine in 2005.	
	Trombetas mine - Mineracao Rio do Norte	Expansion of mine to support Alunorte and Alumar alumina refinery expansions expected to be complete in late 2002. Production at capacity dependent on markets.	5 200 000
China	Baise Yinhai - Pechiney and Minmetals	Planning for new 400 000-t/y alumina refinery in Guangxi, with later expansion potential to 2 Mt/y.	
	Denfeng Aluminium Plant	Looking for investors to complete a new 100 000-t/y refinery.	
	Great Wall Aluminium	Expansion to 1.4 Mt/y.	250 000
	Guizhou refinery - Chalco	Refinery modernization was to be completed in late 2001. Capacity of plant expected to be 500 000 t/y after ramp up.	100 000
	Guizhou refinery - Chalco	Proposes to double the capacity of refinery.	
	Guizhou - Zunyi Aluminum	Construction started on new 400 000-t/y refinery. Completion expected in 2004.	400 000
	Jinbei Aluminum Plant	Feasibility study on new 1-Mt/y alumina refinery expected to be completed in 2002.	
	Pingguo refinery joint venture with Alcoa - Chalco	Construction started in 2001 to double the capacity of refinery by 2003.	400 000
	Shandong Aluminum	Expansion of refinery.	250 000
	Zhongzhou refinery - Chalco	Proposes to double the capacity of refinery from current capacity of 450 000 t/y.	
Guinea	Dian-Dian - Russian Aluminium	Government approval of bauxite mine and refinery. Port and rail facilities to be constructed. Proposed capacity of 11 Mt/y of bauxite, 1.2 Mt/y of alumina.	
	Societe Bauxite du Kinda - Russian Aluminium	Russian Aluminum signed 25-year management agreement. Expansion of mine from 1.5 Mt/y to 2.5 Mt/y in 2004.	
	Guinea Aluminium Products Co.	Discussions on expansion of Friguia alumina plant by 350 000 t/y, hydro dam and 240 000-t/y smelter.	
	Sangarédi refinery - Government of Guinea	Possible new 2.4-Mt/y refinery.	
India	Gujarata Alumina Bauxite Ltd.	Proposal for 750 000-t/y refinery in Gujarat. Production would not start until after 2005.	
	Korba - Bharat Aluminium	Expansion of refinery from 180 000 t/y to 830 000 t/y approved. Project expected to be completed in 2005.	
	Nalco - Damanjoi refinery	Refining capacity at Damanjoi doubled from 800 000 t/y to 1.6 Mt/y.	800 000
	Renukoot - Hindalco	Expansion of refinery under way	200 000
	Pechiney, SA	Interested in constructing a 1-Mt/y alumina refinery in Orissa, India; feasibility study under way, decision expected in 2003.	
	Utkal - Alcan, Hindalco	Bauxite mine and alumina refinery in Orissa. Hydro Aluminum withdrew from project. Refinery capacity may be 1-3 Mt/y.	
Iran		Alumina refinery expected to open in 2002.	
Jamaica	Kirkvine and Ewarton	Glencore purchased refineries from Alcan.	
	Alumina Partners of Jamaica - Kaiser and Hydro Aluminium	Expansion of Alpart refinery from 1.45 Mt/y to 1.7 Mt/y by early 2003.	250 000
	Clarendon refinery - Alcoa and Jamalco	Agreement on 250 000-t/y expansion of refinery.	250 000

Country	Project/Company	Remarks	Near-Term Change
Kazakhstan	Pavlodar	Alumina plant expansion under way to a total capacity of 1.5 Mt/y by 2005.	400 000
Russia	Achinsk Refinery - Russian Aluminum	Planned to increase alumina capacity to 1 Mt/y.	150 000
	Russian Aluminum	Plans to become self-sufficient in alumina.	
	South Urals bauxite mine - Sual Group	Plans to close mine in 2002. Produced approximately 300 000 t in 2001.	
	Timan bauxite mine - Sual Group	Mine at Sredne-Timan in Komi Republic under development. Expected capacity to eventually reach 3 Mt/y of bauxite. Possible new 1.2-Mt/y refinery and smelter to be associated with mine. Rail line to be completed in mid-2002. Hatch and Associates awarded contract for prefeasibility and engineering work on alumina refinery and smelter. Capacity expanded to 1.2 Mt/y of bauxite in 2001.	750 000
	Oradea Refinery Russian Aluminum	Plans to close and place refinery on care and maintainance.	-200 000
Spain	San Ciprian - Alcoa	Expansion/modernization capacity increase to 1.3 Mt/y completed in 2001.	200 000
Suriname	Bakhuis - Pechiney and government of Suriname	Study for new mine and 1-Mt/y refinery.	
Ukraine	Nikolayev - Russian Aluminium	Expansion of capacity to 1.5 Mt/y by 2005, 1.3 Mt/y in 2002 from 1.1 Mt/y.	200 000
United States	Granercy alumina refinery - Kaiser	Completed rebuild and re-opened Gramercy alumina plant with capacity of 1.08 Mt/y.	1 080 000
	Point Comfort - Alcoa	Alumina output reduced.	-500 000
	Burnside - Ormet Corp.	Indefinite closure planned.	-600 000
U.S. Virgin Islands	St. Croix refinery - Alcoa	600 000 t/y-refinery closed.	-400 000
Vietnam	Government of Vietnam	Planning to start construction of a 300 000-t/y alumina refinery in 2002.	
	Dac Nong - China Non-Ferrous Corp. / Vimico	Memorandum of Understanding on a new feasibility study for a potential new 1Mt/y refinery and bauxite mine. Production for export and a possible local 75 000-t/y smelter.	
Venezuela	Bauxilium - CVG Bauxilum/Pechiney	Refinery expansion under way to 2 Mt/y.	300 000
	Bauxilium - CVG Bauxilum/Pechiney	Planned expansion from 260 000 t/y to 410 000 t/y on hold.	

Source: Natural Resources Canada, based on published reports.

TABLE 12. SMELTER PROJECTS

Country	Project/Company	Remarks	Near-Term Change Amount (t/y)
Africa	Hillside Smelter -BHP-Billiton	Expansion announced for completion in 2004.	132 000
Argentina	Puerto Madryn - Aluar	Awarding contracts in early 2002 to expand capacity to 400 000 t/y.	140 000
Australia	Aldoga Consortium	Proposed smelter near Gladstone received major project status. Letter of intent with Russian Aluminium on a joint venture feasibility study. Construction could start in 2002.	
	Tomago Smelter - Tomago Aluminium Pty Ltd.	Partners approved expansion in capacity, completion expected 2006.	
Azerbaijan	Azerbaijan Aluminum	Planning restart of smelter with potential expansion to 120 000 t/y .	
Brazil	Albras - CVRD	Expanded capacity operational by 2002.	45 000
	Albras - CVRD	Consideration of further expansion in capacity from 406 000 t/y to 580 000 t/y	
	Sorocoba Smelter - Cia Brasileira de Aluminio	Expansion of smelter under way from 230 000 t/y to 340 000 t/y. To be completed in 2003.	110 000
Bahrain	Aluminum Bahrain	Company has approved expansion from 509 000 t/y to 750 000 t/y.	250 000
	Aluminum Bahrain - Alcoa	Possible additional expansion to total capacity of 1 Mt/y.	
Canada	Alcan - Alma	Completed construction and start-up of new 400 000-t/y smelter.	400 000
	Alouette Smelter expansion - Alouette Inc.	Expansion approved, completion expected in 2005. Discussed in text.	300 000
	Proposed Newfoundland hydro electricity project and smelter - Alcoa	Discussed in text.	
Chile	Alumysa Proposed smelter - Noranda	Environmental and social studies under way for a proposed US$2.75 million hydro-electric project and smelter near Puerto Aisen.	
China	Aba Aluminium	Proposal for expansion from 14 000 t/y to 150 000 t/y approved by State, looking for investors.	
	Guangxi - Baise Yinhai Aluminium Co.	Constructing a new 52 000-t/y smelter with expected completion in 2002. When complete, proposes to double capacity.	50 000
	Baiyin Aluminium Smelter	Expansion to 130 000 t/y by 2002.	58 000
	Baotou Aluminium	Construction under way of a 50 000-t/y expansion of capacity to 160 000 t/y.	50 000
	Emeishan Aluminium Industry Consortium	First phase of expansion to 73 000 t/y completed early 2002. Subsequent expansions to 223 000 t by 2003 and 300 000 t/y by 2005.	50 000
	Fushun Aluminium Company	Replacement smelter start-up expected in July 2002 with completion in 2003. Considering further expansion.	90 000
	Guizhou - Chalco	Expansion of smelter under way to reach 395 000 t/y in 2004.	160 000
	Guizhou - Zunyi Aluminium plant	Expansion from 32 000 t/y to 132 000-t/y capacity started in 2001.	100 000
	Haixing - Chalco	Purchased by Chalco. Trials at new smelter in Qinghai Province starting up. Expected to reach full capacity 2002.	55 000
	Jiaozuo Wanfang Aluminium Co.	Smelter expansion to 180 000 t/y approved and under way. Further expansion expected to 300 000 t/y by 2004.	70 000
	Lanzhou Aluminium Co.	New 100 000-t/y smelter start up at end of 2001, closure of 50 000 t/y, total capacity to 182 000 t/y.	50 000
	Lanzhou Aluminium Co.	Feasibility studies for possible new 150 000-t/y smelter in Lainhai, Gansu. Decision expected 2002.	
	Nantun Shandong Smelter -Yankuang Group	Proposed 140 000-t/y smelter, expected to be in operation in 2004.	140 000
	Nanping Aluminum Industry Co.	Started construction of 50 000 t/y expansion to boost capacity to 80 000 t/y.	50 000
	Ningxia Zhongning aluminium smelter	Construction started on new smelter.	130 000
	Pingguo Smelter - Chalco	Expansion under way to be completed by 2005. Plans to expand by a further 220 000 t/y. Joint venture with Alcoa.	50 000
	Pingguo - Chalco - joint venture with Alcoa	Proposed tripling of capacity of the Pingguo aluminium smelter.	355 000
	Qinghai Aluminium	Expansion to 250 000 t/y expected to be completed by year-end.	50 000
	Qingtongxia Aluminium Smelter	Expansion completed. Plans to further upgrade existing plant. Alcan signed Memorandum of Understanding on a joint venture to have 50% interest in smelter and planned expansion.	130 000
	Shanxi smelter - Chalco	New 240 000-t/y smelter planned by 2005 with final capacity of 280 000 t/y in 2006.	
	Shanxi - Shanxi Guanlu Co. Ltd.	Company has approved 200 000-t/y expansion of smelter, seeking official approvals.	
	Shanxi - Taiyuan Aluminium Works	Expansion of smelter from 30 000 t/y to 110 000 t/y.	80 000

Country	Project/Company	Comments	Near-Term Change Amount (t/y)
China	Xiezhou Aluminium	Expansion of smelter from 33 000 t/y to 110 000 t/y completed. Plans further expansion to 200 000 t/y by 2005.	70 000
	Xiangxiang Aluminium Works	Seeking investors for expansion of plant from 12 000 t/y to 100 000 t/y.	
	Xuzhou smelter proposal - Jiangsu Aluminium	Decided to postpone new 100 000-t/y smelter.	
	Yichuan Power Group and Xinyuan Industry	New 100 000-t/y smelter to start production in 2003.	100 000
	Yunnan Aluminium - Kunming Smelter	Planned modernization of smelter from Soderberg to prebake technology.	175 000
	Zhenxing Group Co.	Construction of a 40 000-t/y expansion to total capacity of 60 000 t/y expected to be completed in 2002.	40 000
	Zouping Aluminium Co. Ltd	Completed first phase construction of new smelter. Expects to double capacity to 66 000 t/y by mid-2002. Plans thereafter to boost production to 200 000 t/y.	66 000
Dubai	Dubal	Upgrading approved.	155 000
	Dubal - Heron Project	Decision to double capacity of smelter postponed to 2002.	
Egypt	Egyptalum	Expansion and modernization under way. Capacity to be raised by 50 000 t/y by 2003 along with conversion of potline #5 to prebake technology.	50 000
Ghana	Volta - Kaiser	Two potlines closed due to lack of power in early 2002.	-80 000
Guinea	Guinea Aluminium Products Co.	Discussions on possible 240 000-t/y smelter.	
Iceland	New Smelter - Alcoa	Joint action plan with Icelandic government on new 320 000-t/y smelter.	
	Noral Project - Reydaral hf/Hydro Aluminium	Construction decision postponed to September 2002 for a new smelter with 240 000-480 000-t/y capacity.	
	Norðurál - Columbia Venture	Completed expansion of the capacity of Grundartangi smelter to 90 000 t/y.	30 000
	Columbia Venture Corp -	Possible expansion to 180 000 t/y and later to 300 000 t/y.	
India	Angul - Nalco	Expects completion of expansion to 345 000 t/y from 230 000 t/y in 2002.	115 000
	Renukoot - Hindalco	Completed 33 000 t/y expansion, plans further 100 000 t/y by 2003.	133 000
	Korba - Bharat Aluminium	Possible expansion of smelter from 100 000 t/y to 300 000 t/y by 2005.	200 000
	Orissa - Hindalco	Possible 300 000-t/y smelter.	
Indonesia	Perak Smelter	Proposed new smelter with capacity of 500 000 t/y.	
Iran	Iran Aluminium Company	Currently working on proposal for Arak smelter (110 000 t/y).	
Kazakhstan	Pavlodar - Aluminum of Kazakhstan	Financing completed for new 80 000-t/y smelter associated with the Pavlodar alumina refinery. Environmental and socio-economic discussions with public held in 2001.	80 000
Malaysia	Perak State Development Corporation / Charus Development Corporation	Potential new 500 000-t/y smelter to start construction in 2002 with completion in 2005.	
Mozambique	Mozal - Billiton and partners	Expansion of capacity of the Mozal smelter under way from 250 000 t/y to 500 000 t/y. Management contract awarded to SNC Lavalin of Canada and Murray and Roberts Engineering Solutions of South Africa.	250 000
Nigeria	Ikot-Abasi	Work under way to re-open the 193 000-t/y smelter.	
Netherlands	Vlissingen - Pechiney	Contract to SNC-Lavalin for modernization.	80 000
Norway	Sunndal - Hydro Aluminium	New prebake potline, closure of older potline.	168 000
	Mosjøen - Elkem	Modernization and expansion under way, 60% complete in early 2002.	75 000
	Lista - Elkem	Modernization completed.	
Qatar	Ras Laffan - United Development Co, Ferrostaal/ JGC Corp	Consortium's proposal for smelter in NE Qatar, has received licence to build smelter.	500 000
Romania	Alro smelter	To be sold by tender.	
Russia	Bratsk Aluminum smelter - Russian Aluminium	Feasibility studies and tests under way for conversion to prebaked anodes.	
	Komi	Hatch and Associates awarded contract for prefeasibility and engineering work on alumina refinery and smelter. Smelter capacity expected to be 500 000 t/y.	
	Leningrad - Vsevolozhsk Aluminum Smelter	Proposed smelter with a capacity of 147 000 t/y did not receive government approvals.	
	Leningrad - Sosnovy Bor Aluminum Works/Alutec Inc	Proposed new smelter, USTDA grant for research and design. Construction could start in 2003 on smelter. First stage of 24 000 t/y could be operational in 2004, with expansions thereafter to over 400 000 t/y.	
	Leningrad Volkhov Aluminum and Glinozyom.	Possible expansion and proposal for a new 200 000-t/y smelter.	

Country	Project/Company	Remarks	Near-Term Change Amount
			(t/y)
Russia	Sayansk - Russian Aluminium	SNC-Lavalin-Russian Aluminum Memorandum of Cooperation on expansion study and feasibility study for expansion of smelter from 400 000 t/y to 660 000 t/y.	
	Irkutsk - Alucom-Taishet	Pilot smelter start-up early 2002. Proposal for new 250 000-t/y smelter.	
	Irkutsk smelter - Sual Group	Modernization under way will increase capacity. Company plans additional potline to raise capacity by additional 75 000 t/y.	
	Bogoslovsk smelter - Sual Group	Modernization under way. Feasibility study on a new 300 000-t/y smelter.	
	Kandalaksha smelter - Sual Group	Replacement of older cells with prebaked anode cells to start in 2002.	
	Krasnoyarsk - Russian Aluminium	Modernization under way.	50 000
	Urals smelter - Sual Group	Potlines being replaced.	
Slovakia	Ziar-nad-Hronom - Slovalco A.S.	Expansion of smelter under way, completion expected 2003.	50 000
Slovenia	Kidricevo Talum d.o.o. smelter	Expansion of smelter under way, completion expected 2003.	80 000
Ukraine	Pervomaisk - Russian Aluminium	Planning for a new smelter.	
	Zaporozhye Aluminum Combine	Installation of prebaked anodes to increase capacity to 157 000 t/y from 110 000 t/y.	47 000
Undetermined	Pechiney	New US$2.2 billion AP50 smelter planned for one of several countries, 460 000 t/y.	
United States	Alcoa - Warrick	Power failure - loss of capacity to be rebuilt in 2002.	-75 000
Vietnam	Government of Vietnam	Start of new 75 000-t/y smelter planned in 2002.	
Venezuela	Alcasa - CVG Glencore	Restarting closed potline (50 000 t/y); considering an additional potline with additional 200 000-t/y capacity.	50 000
	Purerto Madryn smelter - Aluar	A planned expansion from 260 000 t/y to 410 000 t/y is currently on hold.	
Total			5 504 000

Source: Natural Resources Canada, based on published media reports.

Antimony

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Note: This is a brief review of antimony in Canada with general information and not a comprehensive review.

The chemical symbol for antimony is Sb.

Canada produces a very minor share, less than 1%, of the approximately 150 000 t that the United States Geological Survey (USGS) estimated to have been produced worldwide in 2001. The second largest producer of antimony is the Russian Federation, which produces between 3 and 4% of the world's total production. China is the dominant force in the world antimony market, producing an estimated 89% of world production, according to USGS data.

The largest single application for antimony is in the manufacture of flame retardants used in plastics, vinyls and synthetic fibres. Antimony is also used as an alloying element in lead used for making automotive batteries; the addition of antimony increases the strength and hardness of the lead. When lead-acid automotive and lead-acid standby batteries are recycled, much of the contained antimony can be recovered for making antimonial lead for use in the battery-making process. Antimony metal is also used in solders and for bearings. Stibnite (Sb_2S_3) is the predominant ore mineral of antimony. Antimony metal is sold as regulus, grading 96% Sb. Prices for antimony largely depend upon the Chinese production (Figure 1); with the increased production from China, prices have declined dramatically since 1994.

Antimony is alloyed with lead to improve the hardness. The resultant "hard lead," with a 3-9% antimony content, has superior strength and corrosion resistance relative to unalloyed lead. Hard lead is used in the grids, terminals and lead-oxide paste of automotive and standby batteries. In addition, antimonial lead lining is used to protect pipes, valves, pumps and sheets used in the chemical industry. Higher antimony contents of up to 13% are needed for casting alloys.

Other elements can be used to harden lead, such as cadmium, calcium, copper, selenium, strontium, sulphur or tin. Hydrated aluminum oxide and certain organic compounds can be used for flame retardants. In paints, pigments and enamels, various compounds of chromium, tin, zinc or zirconium can be used in place of antimony.

CANADIAN DEVELOPMENTS

Antimony is recovered in Canada from primary concentrates and from recycled automotive batteries at two primary lead smelters that produce antimony-lead alloys. These alloys are used for lead-acid battery production. Canadian antimony mines remained closed, primarily due to low antimony prices.

Teck Cominco Limited <www.teckcominco.com> operates lead-zinc mines whose ore contains significant amounts of by-product antimony. At its Trail, British Columbia, lead-zinc smelter/refinery, Cominco recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

Noranda Inc. <www.noranda.com> operates the Brunswick lead-zinc mine at Bathurst, New Brunswick, whose ore contains significant amounts of by-product antimony. At Noranda's lead smelter located in Belledune in the same province, the company recovers antimony from concentrates and from recycled lead-acid batteries in order to produce an antimony-lead alloy.

The two Canadian secondary lead smelters use scrap batteries for feed and these batteries contain antimony alloyed with the lead; the antimony in these batteries can be recovered with the lead. The two secondary lead smelters are owned by **Tonolli Canada Ltd**. in Toronto, Ontario, and **Nova Pb Inc.** near Montréal, Quebec. These two plants are dependent upon recyclable lead-acid batteries from neighbouring states, such as New York, to supplement feed from Canadian sources; without such imports, there is insufficient feed in Canada to keep both plants operating viably.

Canadian Antimony Mines

Canadian antimony mining has ceased due to the low price of antimony brought about by the large Chinese exports.

Apocan Inc., a subsidiary of Amspec of the United States <www.amspecorp.com>, owns the Lake George antimony mine in New Brunswick. Lower antimony prices forced the mine's closure in 1989. In mid-1994, Apocan decided to proceed with permitting and the rehabilitation work needed to re-open the mine. In October 1995, final permits were obtained for the mine re-opening. The mine started producing in mid-1996 and was officially opened in November 1996. However, mechanical problems with the hoist forced a shut-down of the operation at year-end. Before repairs could be completed, antimony prices dropped so low that the company decided to keep the operation shut. Since that time, the mine was permitted to flood. In the mid-1990s, the company considered building an antimony smelter to process the concentrate but there was significant local opposition to the idea. With the increase in prices in late 2002, it is expected that the company will evaluate the re-opening of the operation.

Roycefield Resources Ltd. developed the Beaver Brook mine, near Gander, in the province of Newfoundland and Labrador. The mine began underground development in 1995. In May 1996, the province awarded the company "EDGE" status, which conferred certain tax holidays, start-up assistance, and other assistance to encourage significant new business investment in the province; a condition of granting such status was that Roycefield would process the antimony to antimony trioxide within the province.

The mine/mill operation was built to produce 400 t/d of antimony, based on 13 years of reserves at a 5% antimony cutoff grade. Mining commenced in July 1997 and continued for five months to November, accumulating an ore stockpile for the start-up of the mill. The mill start-up began in November with the first concentrate shipped before year-end. Amalgamet Canada Limited <www.amalgamet.com> and Roycefield had reached an agreement whereby Amalgamet Canada would the the exclusive sales agent for Roycefield's antimony concentrates. The concentrate specifications were 65% Sb with combined arsenic plus lead content not to exceed 0.5% and combined selenium plus mercury content to be less than 10 ppm.

After operating a mini-pilot plant, a demonstration plant was commissioned in January 1998 to further develop Roycefield's hydrometallurgical processing technology, designed to convert the antimony sulphide to antimony trioxide in which sulphur was removed from the concentrates and recovered as elemental sulphur. Roycefield estimated that the commercial hydrometallurgical antimony trioxide and associated chlor-alkali plant for chemical regeneration would cost about $17 million. Low antimony prices forced the company to suspend mill commissioning in February 1998. In mid-July 2000, the company was still maintaining the mine in a care-and-maintenance mode awaiting higher prices. Since that time, Roycefield went into receivership and **Beaver Brook Resources Inc.**, based in Newfoundland and Labrador, is reported to have purchased the mine. As of October 2002, the operation was still on care and maintenance.

PRICES

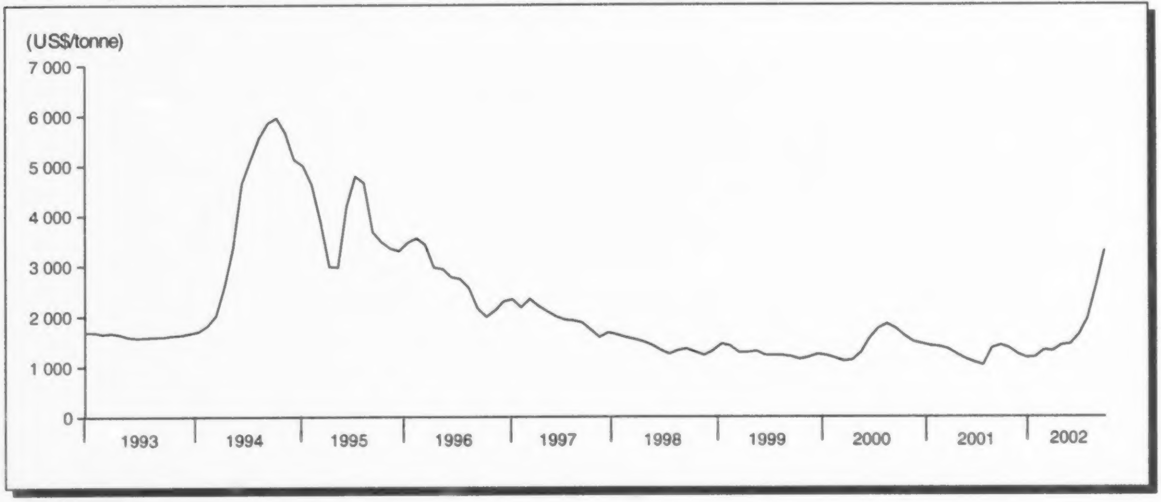
Metal Bulletin's free market prices for antimony regulus grading 99.65% Sb with a maximum selenium content of 50 ppm are shown in Figure 1 for the period 1993 to 2002. Prices increased rapidly from US$1569/t in July 1993 to reach a maximum of US$5955/t in November 1994. This large price increase of nearly 380% in 16 months encouraged producers to increase production capacity either through the development of antimony sources or the re-opening of those previously shut down. In addition, manufacturers began recycling their off-specification material while producers concentrated on increasing recovery rates. Simultaneously, however, the rapid price increase and high price discouraged future antimony use.

For the period 1993 to September 2002, monthly prices peaked at US$5995/t; they declined to US$2974/t by June 1995 and recovered rapidly to US$4787/t by August 1995. From then onward, prices trended downwards to US$1108/t in April 2000, a decline of nearly US$4900/t. Since that time, prices drifted upwards to US$1844/t and then declined to US$1493/t by year-end 2000, reaching a nadir of US$1025/t in August 2001. Since then, prices have increased. The increase was hastened by problems at Chinese mines in the summer of 2002, which sent prices up to an average of US$2585/t in September 2002, the last month for which data were available at the time of writing.

As can be seen from the USGS data, China is the dominant antimony producer. In 1993, China's share of world production was 69%; it rose to 71% in 1994 and then, from 1995 to 1999, it remained between 80% and 85%, thereafter rising to an estimated 89% in 2001. Figure 2 shows Chinese and world production of antimony from 1997 to 2001. Data for 2001 are estimated.

Figure 1

Antimony Prices, Metal Bulletin Monthly Average,[1] 1993-2002

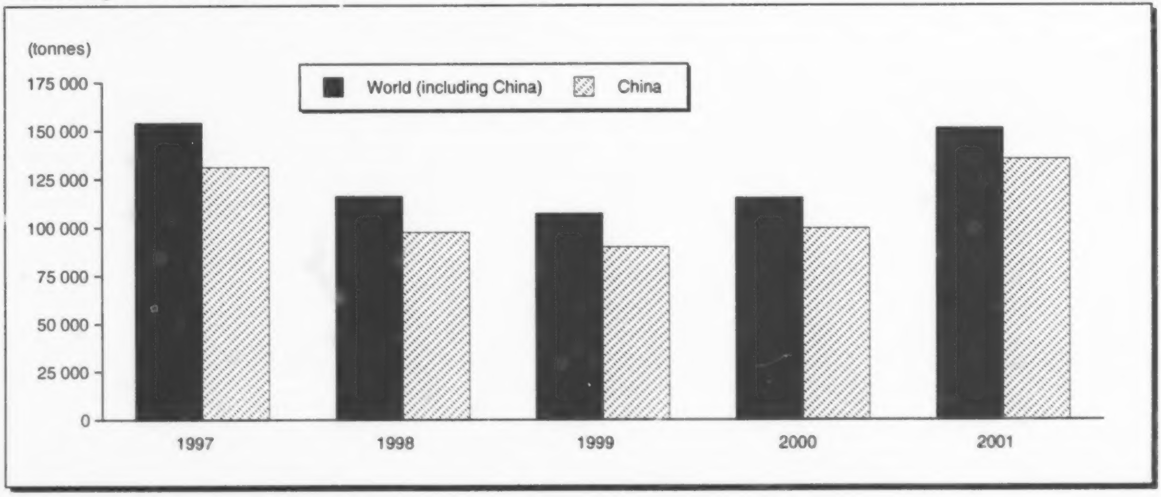


Source: *Metal Bulletin.*

[1] Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, regulus 99.65%, max. Se 50 ppm.

Figure 2

Antimony Production, 1997-2001



Source: United States Geological Survey.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet include:

- United States Geological Survey (USGS): <http://minerals.usgs.gov/minerals/pubs/commodity/antimony/>
- Search by company name in the SEDAR data base for companies publicly traded in Canada: <www.sedar.com/search/search_form_pc_en.htm>
- *Canadian Mining Journal*: <www.canadianminingjournal.com>
- *Northern Miner* (daily headlines): <www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as <www.google.com/advanced_search>
- For physical and chemical properties, concentrations in various media, etc.: <www.webelements.com/webelements/elements/text/Sb/key.html>
- Yahoo search of metals and minerals (use keyword "antimony"): <biz.yahoo.com/news/mining.html>
- *American Metal Market*, search (some articles do not require paid subscription to access): <www.amm.com>
- *Mining Journal*, search (some articles do not require paid subscription to access): <www.mining-journal.com/index1.htm>
- *Metal Bulletin* (information by paid subscription): <www.metalbulletin.co.uk>

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available at the company's web site at <www.roskill.co.uk/antimony.html>.

Studies from other sources may also be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of October 2002. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about antimony in Canada. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States	EU
Item No.	Description	MFN	GPT	USA	Canada	MFN
2617.10	Antimony ores and concentrates	Free	Free	Free	Free	Free
2825.80	Antimony oxides	Free	Free	Free	Free	7.2%
2918.13.00.10	Antimony potassium tartrates	Free	Free	Free	Free	6.5%
81.10	Antimony and articles thereof, including waste and scrap					
8110.10.00.10	Unwrought antimony; not alloyed; powders, not alloyed	Free	Free	Free	Free	7%
8110.10.00.20	Unwrought antimony, alloyed; waste and scrap; powders, alloyed; articles of antimony	Free	Free	Free	Free	Free-7%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001).

TABLE 1. CANADA, ANTIMONY PRODUCTION, IMPORTS AND EXPORTS, 1999-2001, AND USE, 1996-2000

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION							
	New Brunswick	109 845	226	149 400	320	136 000	300
	British Columbia	246 900	507	214 700	461	97 768	216
	Total	356 745	733	364 100	781	233 768	516
IMPORTS							
2617.10	Antimony ores and concentrates						
	United States	31	99	23	67	14	50
	Australia	–	–	–	–	. . .	. . .
	China	–	–	. . .	1	–	–
	Total	31	99	23	68	14	50
2825.80	Antimony oxides						
	United States	1 481	4 781	1 716	5 801	1 419	4 885
	Mexico	–	–	–	–	146	391
	Belgium	20	48	105	310	132	354
	China	95	193	81	202	79	205
	Other countries	587	2 100	159	569	–	–
	Total	2 183	7 122	2 061	6 882	1 776	5 835
2918.13.10.10	Antimony potassium tartrates						
	Italy	7	11	66	97	58	118
	China	12	24	15	23	21	38
	United States	7	13	5	10	15	25
	Switzerland	. . .	. . .	4	8	1	3
	Other countries	3	5	. . .	. . .	. . .	. . .
	Total	29	53	90	138	95	184
8110.00.10	Unwrought antimony, not alloyed; powders, not alloyed						
	United States	78	299	112	413	77	256
	China	127	469	41	157	33	119
	Hong Kong	–	–	11	43	13	37
	Sweden	–	–	–	–	2	8
	Other countries	24	88	13	41	1	4
	Total	229	856	177	654	126	424
8110.00.20.00	Unwrought antimony; waste and scrap; powders, alloyed; articles of antimony						
	China	67	148	105	268	152	349
	United States	84	168	173	404	85	199
	Hong Kong	–	–	–	–	45	77
	Germany	–	–	15	52	18	73
	Other countries	4	16	12	30	19	52
	Total	155	332	305	754	319	750
	Total imports		8 462		8 496		7 243
EXPORTS							
2617.10	Antimony ores and concentrates	–	–	–	–	–	–
2825.80	Antimony oxides	–	–	–	–	–	–
	United States	–	–	–	–	20	43
	Total	–	–	–	–	20	43
8110.00	Antimony and articles thereof, including waste and scrap						
	United States	56	491	62	444	69	425
	Germany	–	–	–	–	. . .	21
	Other countries	–	–	. . .	3	. . .	16
	Total	56	491	62	447	69	462
	Total exports		491		447		505

		1996 (a)	1997 (a)	1998	1999	2000 (p)
				(kg)		
USE (1)						
	Antimony metal used for, or in the production of:					
	Antimonial lead	600 981	1 082 374	695 539	792 018	713 226
	Babbit	76 149	65 032	70 162	62 669	56 369
	Other uses (2)	11 670	10 804	25 554	10 696	7 910
	Total	688 800	1 158 210	791 255	865 383	777 505
	Held by users on December 31 (1)	153 734	431 702	89 336	248 754	304 213

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.

(a) Increase in number of companies being surveyed.

(1) Available data as reported by users. (2) Includes solder, type metal and miscellaneous uses.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, USE AND USERS' STOCKS OF ANTIMONY,$^{(1)}$ 1970, 1975 AND 1980-2000

	Use		On Hand at End of Year	
	Antimony Metal	Antimonial Lead Alloy (2)	Antimony Metal	Antimonial Lead Alloy (2)
		(kilograms)		
1970	518 007	635 212	131 501	91 563
1975	454 164	723 155	116 760	170 478
1980	369 732	643 983	42 389	51 405
1981	209 829	691 180	35 105	151 400
1982	161 034	605 502	39 799	76 979
1983	169 648	560 705	24 381	130 104
1984	342 705	648 413	33 524	23 319
1985	184 993	826 846	24 512	20 298
1986	539 655	759 876	28 422	104 360
1987	540 147	692 750	21 172	164 782
1988	585 600	989 100	7 386	142 961
1989	442 942	1 075 354	17 023	135 977
1990	294 321	922 127	13 805	99 882
1991	406 221	924 728	20 248	131 779
1992	355 963	829 795	99 872	149 850
1993	688 542	(r) 884 344	41 123	(r) 127 382
1994	1 084 863	856 959	80 123	135 267
1995	988 338	822 848	150 064	208 132
1996	688 800	733 730	153 734	115 878
1997	1 158 210	665 751	431 702	156 725
1998	791 255	589 087	89 336	190 962
1999	865 383	634 294	248 754	323 633
2000	(p) 777 505	(a) 674 829	304 213	250 406

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(a) Increase in number of companies being surveyed.

(1) Available data, as reported by users. (2) Antimony content of primary and recycled antimonial-lead alloys.

TABLE 3. MINE PRODUCTION OF ANTIMONY, 1992-2001

Country	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
					(tonnes)					
China	59,400	60,000	91,000	125,000	129,000	131,100	97,400	89,600	(r) 99 300	92,440
Bolivia	6,022	5,556	7,050	6,426	6,488	5,999	4,735	2,790	1,807	2,072
South Africa	3,951	4,100	4,534	5,537	5,137	3,415	4,243	5,278	(r) 4 104	4,827
Russia	4,000	4,000	3,000	3,000	6,000	6,000	4,000	4,356	(r) 8 000	(r) 4 152
Australia	1,701	2,300	1,300	900	1,800	1,900	1,800	1,679	1,511	1,380
Tajikistan	1,500	2,000	2,000	1,000	1,000	1,200	1,500	1,800	2,000	2,500
Kyrgyzstan	3,000	2,500	9,588	4,778	6,002	3,062	1,298	1,320	1,505	1,500
Other (1)	1,806	1,618	1,575	1,196	2,171	957	1,022	771	1,110	622
Other (2)	3,128	1,876	2,479	2,928	2,657	2,487	1,397	826	389	0
Total	84,508	83,950	122,526	150,765	160,255	156,120	117,395	108,420	(r) 119 826	(r) 109 493
Top 7 as a % of tota	94%	96%	97%	97%	97%	98%	98%	98%	99%	99%

Source: International Consultative Group on Nonferrous Metals Statistics, 2002

(r) Revised.

Notes: Other (1) = Canada, Peru, Thailand and Turkey. Other (2) = Czechoslovakia, Guatemala, Honduras, Mexico, Morocco, Romania, United States, Yugoslavia and Zimbabwe.

Bismuth

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Note: This is a brief review of bismuth in Canada with general information and not a comprehensive review.

The chemical symbol for bismuth is Bi.

As the only "edible" heavy metal, bismuth is used in pharmaceutical products such as non-prescription stomach remedies, which contain bismuth subsalicylate. Bismuth is also used in antibiotics that treat stomach ulcers and burns.

In metallurgy, bismuth is used as an additive or alloying element, for example, as a hardening agent in lead used in lead-acid automotive and standby batteries. Bismuth's low melting point is utilized in fusible links, which are used to engage automatic fire sprinkler systems. When bismuth solidifies, it expands, unlike most other metals. This property improves "pressure tightness" and reduces shrinkage when bismuth is added to alloys. Other bismuth applications include use in ceramics, glass, electronics, and cosmetics.

The outlook for bismuth use is thought to be encouraging due to increasing restrictions on the use of lead. Such restrictions have meant that bismuth is used to replace lead in some potable water equipment, as a substitute for shotgun pellets used to hunt waterfowl, and to increase the machineability of alloys.

The world mine production of bismuth in 2001 was estimated by the United States Geological Survey (USGS) to have been 5810 t. Estimated Chinese production increased sharply from 400 t in 1999 to 2500 t in 2000. This increased Chinese production base was estimated to have continued into 2001 as well. According to the USGS, Canada produced about 4% of the world's bismuth at the mine stage. Other than China, which produced an estimated 42% of world production in 2001, the large producers are Mexico and Peru, which produce about 1000 t each, followed by Boliva at 750 t.

CANADIAN DEVELOPMENTS

Canadian primary bismuth production for the period 1993 to 2001 is shown below.

PRIMARY BISMUTH PRODUCTION IN CANADA

	New Brunswick	British Columbia	Total	Value
		(tonnes)		($000)
1995	148	11	159	1 815
1996	w	w	150	1 598
1997	182	14	196	1 956
1998	175	11	186	2 078
1999	249	16	264	2 941
2000	194	8	202	2 343
2001	252	6	258	3 163
Total	1 200	66	1 415	15 894

Source: Natural Resources Canada.
w Withheld.
Note: These data do not include bismuth recovered from recycling.

Canadian refined bismuth production data are withheld for reasons of confidentiality.

On average, for the period 1995 to 2001, 85% of Canadian-mined bismuth originated in New Brunswick, from **Noranda Inc.**'s <www.noranda.com> Brunswick mine. Bismuth is a by-product of lead-zinc mining at the Brunswick mine at Bathurst. The metal is recovered at Noranda's lead smelter in Belledune, New Brunswick, as an intermediate bismuth lead alloy.

Teck Cominco Limited <www.teckcominco.com> recovers bismuth metal from the concentrate feed to its Trail, British Columbia, lead-zinc operation.

From 1995 to 1996, **Adex Mining Corp.** evaluated the Mt. Pleasant property in New Brunswick. Adex took bulk samples and undertook a metallurgical research program at the site of the former mine as part of a feasibility study for the production of tin and indium. The ore under consideration also contained 0.08% bismuth. Due in large part to the low indium prices in 1997 and the high estimated capital cost, Adex was unable to develop the orebody. At a rate of 2000 t/d, the mine would have produced approximately 400 t/y of bismuth, thereby increasing primary world bismuth supply by over 10%. The company was delisted in June 1999 but continues to hold the Mt. Pleasant property. Adex did not maintain a web site at the time this article was written.

PRICES

Monthly *Metal Bulletin* prices from 1995 to September 2002 are shown in Figure 1. More detailed price information is available from the Sidech site at <www.sidech.be/more.htm#D>; click the "Graph" link under the heading "World Production and Bismuth Price."

PRODUCT INFORMATION

Those who wish to purchase bismuth should contact the producers. In Canada the following firms produce and sell bismuth:

• Teck Cominco Limited	<www.teckcominco.com>
• Falconbridge Limited	<www.falconbridge.com>

Additional information such as addresses and phone numbers can be found on their respective web sites.

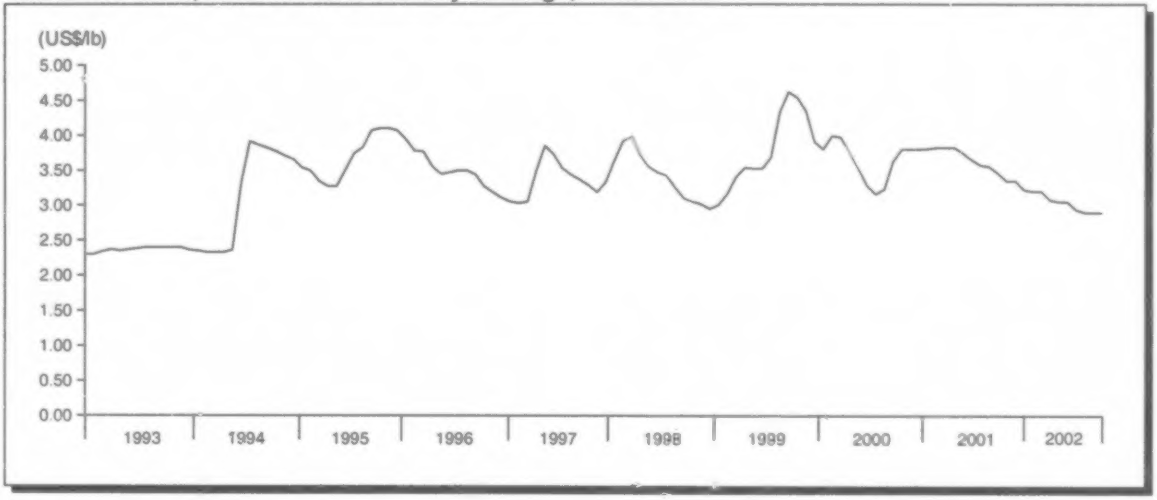
INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2002, include the following:

- United States Geological Survey (USGS): <http://minerals.usgs.gov/minerals/pubs/commodity/bismuth/>
- Search by company name in the SEDAR data base for companies publicly traded in Canada: <www.sedar.com/search/search_form_pc_en.htm>
- *Canadian Mining Journal*: <www.canadianminingjournal.com>
- *Northern Miner* (daily headlines): <www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as <www.google.com/advanced_search>

Figure 1

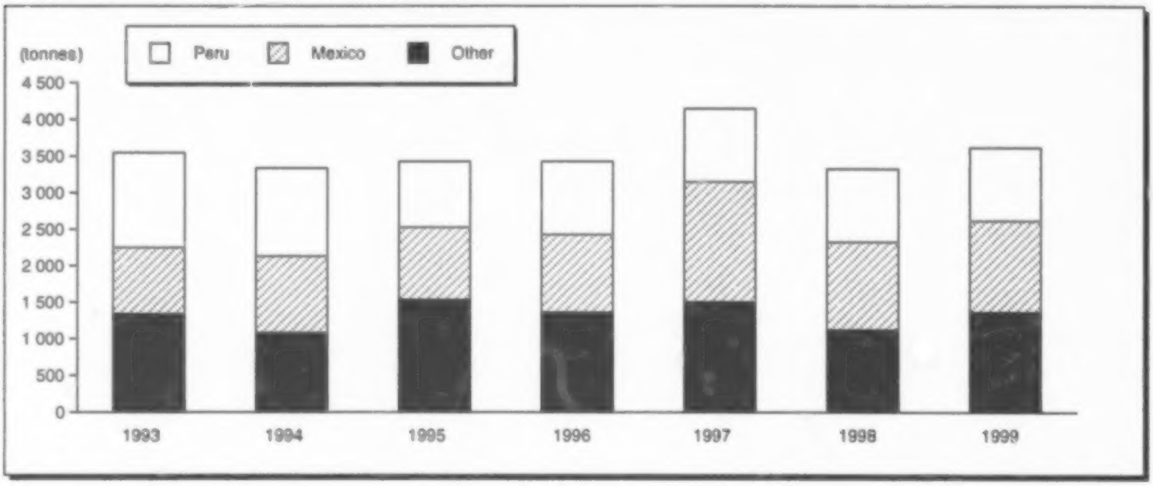
Bismuth Prices, Metal Bulletin Monthly Average,[1] 1993-2002



Source: *Metal Bulletin*.

[1] Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, 99.99% min., tonne lots.

Figure 2
Bismuth, World Mine Production, 1993-99



Source: United States Geological Survey.

- For physical and chemical properties, concentrations in various media, etc.: <www.webelements.com/webelements/elements/text/Bi/key.html>

- *American Metal Market*, search (some articles do not require paid subscription to access): <www.amm.com>

- *Mining Journal*, search (some articles do not require paid subscription to access): <www.mining-journal.com/index1.htm>

- *Metal Bulletin* (information by paid subscription): <www.metalbulletin.co.uk>

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available at the company's web site at <www.roskill.co.uk/bismuth/html>.

Studies from other sources may be available.

OUTLOOK

Bismuth is a by-product metal; the bismuth revenue in the ore mined is only a fraction of the total ore value in almost all cases. When bismuth prices increase because of sharply increased demand, many operations do not have the capacity to increase production significantly. Because the bismuth constitutes a small fraction of the revenue produced at the mine, producers will not increase ore production only because bismuth prices increase. While most metal prices are volatile, the price of minor by-products such as bismuth can be much more volatile due to the inability of producers to capitalize on increased demand. The ability of bismuth to substitute for lead is constrained by the higher price for bismuth and the inability of the bismuth industry to substantially increase production.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of October 2002. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about bismuth in Canada. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2617.90.00.90	Bismuth ores and concentrates	Free	Free	Free	Free
8106.00.10	Unwrought bismuth, not alloyed; powders, not alloyed	Free	Free	Free	Free
8106.00.20	Unwrought bismuth, alloyed; waste and scrap; powders, alloyed; articles of bismuth	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, BISMUTH PRODUCTION AND TRADE, 1999-2001, AND USE, 1996-2000

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION (all forms) (1)							
	New Brunswick	206 572	2 285	194 230	2 250	251 530	3 089
	British Columbia	10 563	117	7 998	93	6 022	74
	Total	217 135	2 402	202 228	2 343	257 552	3 163
EXPORTS							
8106.00	Bismuth and articles thereof, including waste and scrap						
	United States	108 421	1 236	120 275	1 228	42 510	447
	Netherlands	39 977	461	41 090	477	20 110	225
	Belgium	–	–	20 134	207	20 117	212
	Japan	39 574	405	38 088	409	13 096	158
	Other countries	–	–	61 432	716	2 044	30
	Total	187 972	2 102	281 019	3 037	97 877	1 072
IMPORTS							
2836.99.10.10	Bismuth carbonates						
	United States	65 905	189	283 295	849	126 560	387
	Spain	1 922	6	1 495	4	7 574	22
	Germany	–	–	150	. . .	544	2
	Total	67 827	195	284 940	853	134 678	411
8106.00.00.10	Unwrought bismuth, not alloyed; powders, not alloyed						
	China	14 723	160	29 740	357	66 640	584
	United States	25 549	271	7 567	99	32 872	171
	Belgium	6 630	87	8 072	113	11 158	161
	United Kingdom	–	–	4 842	56	7 503	76
	Other countries	601	8	7 899	28	2 473	41
	Total	47 503	526	58 120	653	120 646	1 033
8106.00.00.21	Unwrought bismuth, alloyed; powders, alloyed, articles of bismuth						
	United States	1 506	47	5 149	187	2 329	140
	Mexico	–	–	–	–	1 092	17
	United Kingdom	–	–	–	–	100	5
	Canada	1 003	12	–	–	–	–
	Peru	136	2	–	–	–	–
	Total	2 645	61	5 149	187	3 521	162
8106.00.00.22	Bismuth waste and scrap						
	United States	63 570	782	74 524	936	56 161	741
	Canada	–	–	–	–	3 170	38
	Germany	–	–	–	–	1 137	14
	China	–	–	981	12	–	–
	Total	63 570	782	75 505	948	60 468	793
	Total imports		1 564		2 641		2 399

		1996	**1997**	**1998**	**1999**	**2000** (p)
				(kg)		
USE (1)						
	Use (1), refined metal (available data)					
	Fusible alloys and other alloys	13 118	10 846	14 641	17 066	12 553
	Other uses	–	–	–	–	–
	Total	13 118	10 846	14 641	17 066	12 553

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.
(1) Available data as reported by users.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, BISMUTH PRODUCTION AND USE, 1970, 1975 AND 1980-2001

	Production All Forms (1)	(2) Use
	(kilograms)	
1970	. .	11 135
1975	156 605	29 267
1980	149 366	10 271
1981	167 885	10 094
1982	(r) 189 132	10 074
1983	253 023	7 241
1984	(r) 166 177	9 398
1985	201 489	7 284
1986	152 930	6 617
1987	165 282	4 547
1988	180 907	6 709
1989 (a)	156 727	16 158
1990	74 300	12 032
1991	59 526	11 877
1992	203 789	9 859
1993	128 870	12 133
1994	129 371	12 585
1995	158 641	12 838
1996	149 839	13 118
1997	195 720	10 846
1998	186 400	14 641
1999	217 135	17 066
2000	202 228	12 553
2001 (p)	257 552	. .

Source: Natural Resources Canada.
. . Not available; (p) Preliminary; (r) Revised.
(a) Increase in number of companies being surveyed.
(1) Refined bismuth metal from Canadian ores, plus recoverable bismuth content of bullion and concentrates exported. (2) Refined bismuth metal reported by users.

Cadmium

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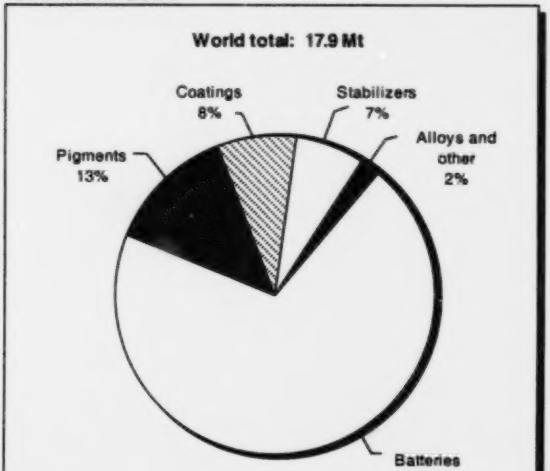
Cadmium (Cd) is a naturally occurring soft, ductile, silvery white metal that melts at 320.9°C. First discovered by Friedrich Stromeyer in Germany in 1817, cadmium owes its name to the Latin word *cadmia* meaning "calamine" (zinc carbonate, $ZnCO_3$) and to the Greek word *kadmeia* with the same meaning. The most common cadmium mineral, greenockite (CdS), is generally found in zinc-bearing ores and is recovered as a by-product during processing. Cadmium is present in the earth's crust in varying concentrations between 0.1 and 0.5 ppm.

Cadmium is used principally in the production of rechargeable nickel-cadmium and silver-cadmium batteries and as a protective coating for other metals, such as electroplating iron and steel products to improve appearance and to protect against corrosion. Another important use is in the manufacture of yellow and red pigments (Figure 1).

Because cadmium is produced as a by-product of zinc mining and refining, the supply of cadmium is more dependent on zinc production than on cadmium demand. Cadmium is also produced from recycled materials such as nickel-cadmium (Ni-Cd) batteries and from some residues or intermediate products. Some 10-15% of total Western World production is from recycled materials. In December 1995, INMETCO commissioned a cadmium recovery plant at its nickel recycling facility in Elwood City, Pennsylvania. This wholly owned subsidiary of Inco Limited can process 3000 t/y of Ni-Cd batteries and is the only Ni-Cd battery recycling facility in North America.

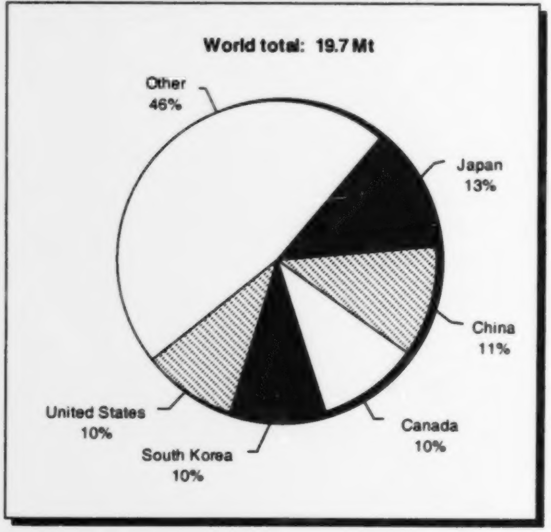
In 2001, preliminary figures indicate that Canada produced about 1429 t of refined cadmium with an

Figure 1
Cadmium Uses



Source: International Cadmium Association.

Figure 2
Refined Cadmium, World Production, 2000



Source: Natural Resources Canada.

estimated value of over $0.8 million. Canada was the world's third largest producer of cadmium in 2000, after Japan and China (Figure 2). Cadmium is produced at all four Canadian zinc plants (refer to the Zinc chapter). About 90% of Canadian cadmium production is exported, mostly to the United States and Japan.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of May 17, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

		Canada			United States	EU	Japan (1)
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO
2617.90.00.10	Cadmium ores and concentrates	Free	Free	Free	Free	Free	Free
2825.90.90.10	Cadmium oxide	Free	Free	Free	Free	3.3%	Free
2830.3	Cadmium sulphide	Free	Free	Free	Free	5.5%	Free
8107.20.10	Unwrought cadmium, not alloyed; powders, not alloyed	Free	Free	Free	Free	3.0%	3%
8107.20.20	Unwrought cadmium, alloyed; waste and scrap; powders, alloyed	Free	Free	Free	Free	Free-3%	3%
8107.9	Cadmium and articles thereof, n.e.s.	3%	Free	Free	Free	4.0%	3%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001); *Custom Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).
n.e.s. Not elsewhere specified.
(1) GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, CADMIUM PRODUCTION, IMPORTS AND EXPORTS, 1999-2001, AND USE, 1998-2000

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION (all forms) (1)							
	New Brunswick	250 419	145	169 710	91	211 478	160
	Quebec	336 674	195	223 068	120	280 375	212
	Ontario	375 789	218	381 000	204	474 000	359
	British Columbia	152 039	88	160 306	86	92 287	70
	Total	1 114 921	647	934 084	501	1 058 140	801
	Refined (2)	1 910 527	...	1 940 917	...	1 429 132	...
EXPORTS							
8107.10	Unwrought cadmium; waste and scrap; powders						
	United States	98 185	688	40 218	1 419	7 028	1 701
	India	–	–	–	–	109 380	393
	Japan	337 644	332	627 840	399	281 829	346
	Belgium	867 254	869	694 640	438	358 799	241
	United Kingdom	189 171	96	200 354	129	126 986	165
	Israel	3 077	70	24	13	93	97
	China	–	–	–	–	42 377	59
	Hong Kong	–	–	–	–	16 971	58
	France	2 500	37	32	38	35	34
	Total	1 497 831	2 092	1 563 108	2 436	943 498	3 094
8107.90	Cadmium and articles thereof, including waste and scrap						
	United States	86 460	123	–	–	6 159	835
	Belgium	483 350	322	478 728	245	412 058	269
	India	21 753	18	–	–	37 299	82
	Israel	–	–	49	27	25	9
	Netherlands	13 870	9	–	–	–	–
	Japan	66 289	80	–	–	–	–
	France	–	–	13	15	–	–
	Hong Kong	–	–	18 000	109	–	–
	Total	671 722	552	496 790	396	455 541	1 195
IMPORTS							
2617.90.00.10	Cadmium ores and concentrates						
	United States	15	...	60	1	9	...
	Japan	6	...	–	–	–	–
	Total	21	...	60	1	9	...
2825.90.90.10	Cadmium oxide						
	United States	493	10	245	5	1 056	24
	United Kingdom	408	8	356	7	178	4
	Belgium	186	4	10	...	190	4
	Total	1 087	22	611	12	1 424	32
2830.30	Cadmium sulphide						
	United States	11 388	6	47	...	241	...
	Total	11 388	6	47	...	241	...
8107.10.00.10	Unwrought cadmium, not alloyed; powders, not alloyed						
	United States	11	...	1 278	33	336	9
	Japan	5	...	9	...	11	...
	Germany	2	...	12	...	–	–
	Total	18	...	1 299	33	347	9

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
IMPORTS (cont'd)							
8107.10.00.20	Unwrought cadmium, alloyed; powders, alloyed						
	Switzerland	–	–	–	–	5	. . .
	Canada	33	1	–	–	–	–
	United States	807	24	3 438	83	–	–
	Germany	10	. . .	8	. . .	–	–
	South Africa	19	1	–	–	–	–
	Japan	26	1	8	. . .	–	–
	Total	895	27	3 454	83	5	. . .
8107.10.00.30	Cadmium waste and scrap						
	United States	153	4	–	–	80	2
	Canada	–	–	127	4	–	–
	Total	153	4	127	4	80	2
8107.90	Cadmium and articles thereof, n.e.s.						
	United States	14 892	210	16 577	276	19 938	439
	China	–	–	–	–	696	21
	United Kingdom	–	–	–	–	189	4
	Mexico	–	–	58	1	33	1
	Belgium	–	–	–	–	38	1
	Germany	–	–	–	–	23	1
	France	123	2	21	. . .	–	–
	Hong Kong	–	–	2	. . .	–	–
	Total	15 015	212	16 658	277	20 917	467

		1998	1999 (a)	2000 (p)(a)
			(kg)	
QUANTITY USED				
	Cadmium metal (3)			
	Plating	4 313	2 250	3 545
	Solders, other alloys and other uses (4)	112 809	136 539	168 759
	Total	117 122	138 789	172 304

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary.
(a) Increase in number of companies being surveyed.
(1) Production includes recoverable content of cadmium in the zinc-lead concentrates shipped. (2) Refined metal produced from domestic and foreign ores and recycled materials. (3) Available data as reported by consumers. (4) Chemicals and pigments.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, CADMIUM PRODUCTION AND EXPORTS, 1975 AND 1980-2001

	Production		Exports
	All Forms (1)	Refined (2)	Cadmium Metal
		(kg)	
1975	1 191 674	1 142 508	637 797
1980	1 033 000	1 302 955	1 095 825
1981	833 788	1 293 265	1 452 904
1982	886 055	1 162 390	769 505
1983	1 107 000	1 296 000	1 365 111
1984	1 605 286	1 756 707	1 369 422
1985	1 716 731	1 696 192	1 477 415
1986	1 483 907	1 551 732	1 382 807
1987	1 481 496	1 571 444	1 156 555
1988	1 663 978	1 693 708	1 142 716
1989	1 710 527	1 619 798	1 433 144
1990	1 333 664	1 470 229	1 282 603
1991	1 549 087	1 829 059	1 452 481
1992	1 393 099	1 962 813	1 579 823
1993	1 161 173	1 888 255	1 856 940
1994	1 499 996	2 173 018	1 903 369
1995	1 686 439	2 349 256	2 462 798
1996	1 540 072	2 432 681	1 693 120
1997	1 272 172	2 260 172	2 538 816
1998	1 179 427	2 090 052	2 049 517
1999	1 114 921	1 910 527	2 169 553
2000	934 084	1 940 917	2 059 898
2001 (p)	1 058 140	1 429 132	1 399 039

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary.

(1) Production includes recoverable content of cadmium in the zinc-lead concentrates shipped. (2) Refined metal produced from domestic and foreign ores and recycled materials.

TABLE 3. WORLD PRODUCTION OF CADMIUM, 1995-2000

Country	1995	1996	1997	1998	1999	2000 (p)
			(tonnes)			
Algeria	50	44	36	13	–	–
Argentina	43	40	45	34	–	–
Australia	838	639	632	585	462	525
Belgium	1 710	1 579	1 420	1 318	1 235	1 148
Brazil	144	132	130	130	130	130
Bulgaria	305	251	183	195	217	233
Canada	2 349	2 433	2 260	2 090	1 911	2 024
China	1 533	1 567	1 982	2 125	2 154	2 200
Finland	534	648	494	520	700	680
France	–	92	309	177	195	160
Germany	1 145	1 145	1 140	1 020	1 145	1 130
India	254	271	296	295	278	315
Italy	308	296	287	328	360	284
Japan	2 652	2 344	2 473	2 337	2 567	2 472
Kazakhstan	794	567	819	1 463	1 061	257
Macedonia	70	12	10	10	10	10
Mexico	689	784	1 223	1 275	1 275	1 268
Namibia	15	7	2	–	–	–
Netherlands	704	603	718	739	731	628
North Korea	200	200	200	200	200	200
Norway	317	274	305	276	244	302
Peru	423	405	359	405	465	458
Poland	–	–	22	–	–	6
Russia	670	730	790	800	900	925
South Korea	1 665	930	1 000	1 178	1 791	1 911
Spain	397	306	301	196	–	–
Thailand	365	385	238	–	–	–
Turkey	36	42	89	69	64	–
Ukraine	15	–	–	–	–	–
United Kingdom	549	537	455	440	547	503
United States	1 266	1 525	2 059	1 240	1 185	1 890
Uzbekistan	100	100	100	100	100	100
Yugoslavia Federation	11	79	45	17	5	–
Total world	20 151	18 967	20 422	19 575	19 932	19 759

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metal Statistics.

– Nil; (p) Preliminary.

TABLE 4. WORLD USE OF CADMIUM, 1995-2000

Country	1995	1996	1997	1998	1999	2000 (p)
			(tonnes)			
Argentina	60	40	45	34	21	12
Australia	24	24	24	24	24	24
Belgium	2 017	2 484	2 020	3 217	3 217	3 217
Brazil	100	100	100	100	100	100
Canada	102	144	139	199	157	159
China	600	600	600	600	600	600
Czech Republic	60	60	60	60	60	60
France	1 968	1 927	1 809	1 800	1 800	1 800
Germany	750	750	750	750	750	750
India	446	446	446	446	446	446
Italy	120	100	100	100	100	100
Japan	8 364	6 527	7 247	5 795	6 550	6 909
Mexico	140	140	140	140	140	140
Poland	26	20	35	10	6	7
Russia	197	600	800	1 086	1 110	1 110
South Africa	20	20	20	20	20	20
South Korea	380	380	380	380	380	380
Sweden	393	259	300	248	296	26
Taiwan	20	20	20	20	20	20
United Kingdom	588	618	631	626	631	585
United States	1 156	2 246	2 506	2 030	1 300	1 270
Yugoslavia Federation	30	30	30	30	30	30
Other	450	191	186	197	210	219
Total world	18 011	17 728	18 390	17 914	17 970	17 986

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metal Statistics.

(p) Preliminary.

Note: Numbers may not add to totals due to rounding.

Calcium Metal

Bill McCutcheon

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Note: This is a brief review of calcium metal in Canada with general information and not a comprehensive review.

The chemical symbol for calcium is Ca.

Timminco Limited <www.timminco.com> has the sole production facility for calcium metal in Canada. These production facilities are located in Timminco's plant at Haley Station, Ontario, where the company produces very high-purity magnesium. The installed capacity of the calcium metal production facilities in 1995 was about 900 t/y. The calcium metal production line has been idle for a number of years due to low prices for the metal that have resulted from increasing exports from China.

Timminco also operates a metal reduction and casting plant in Westmeath, Ontario, located approximately 50 km west of the Haley facility near the town of Renfrew, Ontario. At the Westmeath plant, Timminco produces its proprietary specialty, CAL-AL™, comprising calcium metal and particulated calcium granules. The plant is currently operated using imported calcium metal. In addition, the Westmeath plant produces other specialty materials such as strontium-aluminum alloys and aluminum granules. Other calcium metal producers are located in Russia, the United States (Materials Technologies Inc.), and France (Pechiney Électrométallurgie). With only a few producers, public information about the industry is limited.

Calcium metal is a powerful reduction agent that is used to deoxidize, desulphurize and degas steels and cast irons. In addition, calcium metal is used to reduce oxides of chromium, niobium, samarium, thorium, titanium, uranium and vanadium. Because the metal is so reactive, alloys are often preferred to the pure metal.

Calcium is also used as an alloying element in lead used to manufacture maintenance-free automotive batteries. Calcium metal, when alloyed with the lead, increases the alloy's strength, corrosion resistance, and creep resistance.

Additional information about calcium compounds is available at Timminco's web site.

PRICES

The list price in the *American Metal Market* for 4.5 t (10 000 lb) of full calcium crowns was US$3.85/lb in January 2001, a value that has remained unchanged since the start of 1987. The list price for 4.5 t (10 000 lb) of cut crowns was higher at US$4.02/lb, unchanged since mid-1990. The actual transaction prices paid were likely dependent upon contract details such as quantity, frequency of delivery, impurities, etc. The *American Metal Market* discontinued listing prices of commercial-grade calcium metal in late 2001.

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to October 2002, include the following:

- United States Environmental Protection Agency: <www.epa.gov/epaoswer/other/mining/minedock/id/id4-cal.pdf >
- Search by company name in the SEDAR data base for companies publicly traded in Canada: <www.sedar.com/search/search_form_pc_en.htm>
- *Canadian Mining Journal*: <www.canadianminingjournal.com>
- *Northern Miner* (daily headlines): <www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as <www.google.com/advanced_search>

- For physical and chemical properties, concentrations in various media, etc.: <www.webelements.com/webelements/elements/text/Ca/key.html>
- *American Metal Market*, search (some articles do not require paid subscription to access): <www.amm.com>
- *Mining Journal*, search (some articles do not require paid subscription to access): <www.mining-journal.com/index1.htm>
- *Metal Bulletin* (information by paid subscription): <www.metalbulletin.co.uk>

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services Ltd. in the United Kingdom. Further information is available at the company's web site at <www.roskill.co.uk/calcium.html>.

Studies from other sources may be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of October 2002. (3) This article is not intended to be a comprehensive overview of the industry but, rather, is a brief report to provide information about calcium in Canada. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2805.12	Calcium metal	3%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, CALCIUM METAL PRODUCTION AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(kg)	($000)	(kg)	($000)	(kg)	($000)
PRODUCTION		x	x	x	x	x	x
EXPORTS							
2805.21	Calcium						
	Netherlands	176 664	1 423	79 900	687	85 147	648
	United States	28 641	287	58 695	602	25 505	318
	Brazil	8 160	108	10 599	136	11 152	158
	Chile	1 359	25	3 372	36	6 093	85
	Japan	8 452	140	17 680	306	5 056	78
	Other countries	3 588	38	–	–	24	2
	Total	224 864	2 021	170 246	1 767	133 200	1 289
IMPORTS							
2805.21	Calcium						
	China	714 746	3 656	649 820	3 161	798 387	3 928
	Russia	153 737	804	102 908	499	65 424	330
	France	2 182	33	4 189	62	18 507	265
	Other countries	7 698	79	45 486	342	24 440	88
	Total	878 363	4 572	802 403	4 064	906 758	4 611

Sources: Natural Resources Canada; Statistics Canada.
– Nil; (p) Preliminary; x Confidential.

Cement

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Shipments of cement in 2001 were estimated to be 12.99 Mt valued at $1.31 billion, based on preliminary data. This compares to shipments of 12.61 Mt valued at $1.26 billion in 2000, based on final data (Table 1). Demand for cement in most regions remained firm as the result of an increase of about 5% in gross expenditures on construction and an increase in exports.

CANADIAN INDUSTRY

The Canadian cement industry is diversified and primarily integrated with the construction aggregates and concrete products sectors. Information on the aggregates sector is included in a separate chapter entitled *Mineral Aggregates.*

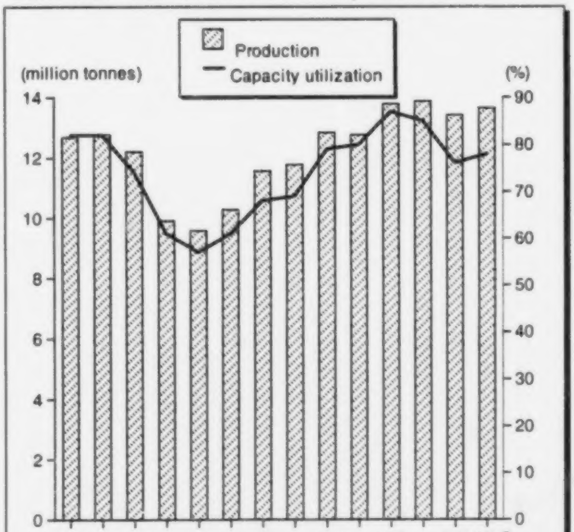
Clinker-producing and finish-grinding capacities of cement plants are listed in Table 2. Reported kiln capacity in 2000 was about 15.7 Mt with about 15.1 Mt active, according to the most recent figures available. Clinker production is more indicative of ultimate cement production capacity because clinker can be stockpiled for later use or sale. The overall output of the cement industry is best represented by total cement shipments plus clinker exports, as shown in Table 3. The average kiln capacity increased to 580 000 t/y in 2000; the average kiln age based on clinker capacity is reported to be about 20 years, according to the Portland Cement Association.

In the Atlantic region, the Lafarge Canada Inc. (Lafarge) plant in Nova Scotia is now the only cement producer in the region following closure in 2000 of the North Star Cement Limited plant in Corner Brook, Newfoundland and Labrador.

In Quebec, three clinker-producing plants account for about 17% of Canada's output. St. Lawrence Cement Inc. (SLC), Lafarge, and Ciment Québec Inc. share markets about equally. (SLC continued with a permitting process to build a new 2-Mt/y cement plant near Greenport, New York.)

In Ontario, clinker-producing plants account for about 51% of Canadian capacity. The Blue Circle Canada Inc. clinker/cement plants located in Bowmanville and St. Marys, which were acquired in early 2001 by Lafarge SA of France via Lafarge's purchase of Blue Circle Industries PLC, were sold to Votorantim Group, one of the largest industrial conglomerates in Brazil and its leading producer of cement. This sale was part of a divestment in accordance with rulings by the Canadian Competition Bureau and the U.S. Federal Trade Commission. (The Ontario plants now operate under the name St. Marys Cement Co., as footnoted in Table 2; also, a

Figure 1
Canadian Cement Production, 1988-2001



Sources: Statistics Canada; Portland Cement Association.
^{P} Preliminary.
Note: Cement production includes clinker exports.

former Blue Circle Inc. plant in Detroit, Michigan, operates as St. Marys Cement Inc. (U.S.).

Western Canada's clinker-producing capacity accounts for about 29% of Canada's total clinker capacity. Both the Inland Cement Limited plant and the Tilbury Cement plant currently operate under the name Lehigh, as footnoted in Table 2.

WORLD DEVELOPMENTS

World cement production in 2000 was 1616 Mt, according to estimates by the United States Geological Survey (USGS). China is the world's largest producer (583 Mt), followed by India (95 Mt), the United States (90 Mt), and Japan (81 Mt).

U.S. anti-dumping duties against grey Portland cement and clinker from Mexico remained in effect in 2001.

USE AND TRADE

Cross-border trade of both cement and clinker varies considerably from year to year depending on construction activity. From 1999 to 2001, annual exports of cement to the United States amounted to 3.5-4.5 Mt and accounted for about one third of total Canadian production (shipments) as defined in Table 1. Exports are mainly destined for the southern Great Lakes and the U.S. Pacific northwestern regions. Similarly, Canada's imports of cement amounted to 0.6-0.8 Mt and related mainly to the equivalent regions.

Low-cost marine transportation has influenced world trade considerably. Total U.S. imports of cement (excluding clinker) for use were about 24 Mt in 2001, or 21% of apparent use. Asian sources (China, Korea and Thailand) have been major suppliers since 1998, according to the USGS.

The importance of supplementary cementing materials (SCMs) for a range of uses is well recognized. About 1.1 Mt of fly ash, accounting for about 22% of reported production, were used in 2001, according to a recent survey by NRCan in cooperation with the Canadian Electricity Association and Canadian Industries Recycling Coal Ash (CIRCA), as shown in Table 4. However, fly ash and other SCMs used for their pozzolanic properties are not differentiated in the international system of harmonized codes; hence, their recognition worldwide tends to be diminished. (Also, timely official data relating to the total use of these materials as inputs to the hydraulic cement industry [SIC code 3521, or the equivalent NAICS code 327310], as well as to the concrete products industry [SIC codes 3541, 3542 and 3549, or their equivalent codes 327330 and 327390], are not readily available.)

TECHNOLOGY

Energy conservation programs by the Canadian cement industry have reduced the energy consumption per unit of production by about 30% since 1974. Although the number of kilns has decreased, their individual capacities have increased and the more efficient dry-process plants now account for more than 95% of total active clinker capacity. The fuel mix has changed considerably away from natural gas and petroleum products toward coal and/or coke. In 2000, of 16 clinker-producing plants, 12 reported using coal and/or coke as their primary fuel. Seven plants reported using waste as an alternative or supplemental fuel, according to the Canadian Portland Cement Association (CPCA). In 2000, the Canadian cement industry consumed, on average, 4482 megajoules per tonne of production. The types of fuel consumed, including waste fuels, are highlighted in Table 2.

Suitable waste materials are an attractive alternative fuel because pyro-processing accounts for more than 80% of total energy needs, or 30-40% of total production costs. In the context of sustainable development of non-renewable fossil fuels, it is apparent that improved waste management involving combustion technology is leading to greater conservation.

Natural Resources Canada (NRCan) continued to seek ideas, advice and financial support for the new International Centre for Sustainable Development of Cement and Concrete (ICON). Although this centre draws on some current initiatives and the expertise of the Canada Centre for Mineral and Energy Technology (CANMET), it is dependent upon new partnerships with industry, academic institutions and other governments for strengthening global efforts relevant to the sustainable development of cement and concrete.

An awareness of the importance of high-volume fly ash concrete is growing; for example, the Greater Vancouver Regional District has established a new web site for EcoSmart^{TM} concrete (high-volume fly ash concrete) in order to provide a forum for information about the benefits, costs and challenges associated with this type of concrete (www.gvrd.bc.ca/services/air/air2000/Ecosmart/html). The EcoSmart Concrete Project also involves studying promising new techniques in intergrinding (blended cement) and precast (pre-manufactured) concrete. Some of these technical initiatives involve collaboration with CANMET and the Electric Power Research Institute (EPRI) of Palo Alto, California.

In late July and early August 2001, the Committee for the Organization of CANMET/ACI Conferences, the National Research Council's Institute for Research in Construction, and others sponsored the Seventh CANMET/ACI International Conference on

Fly Ash, Silica Fume, Slag and Natural Pozzolans in Concrete, held in Madras, India, and the Fifth CANMET/ACI/International Conference on Recent Advances in Concrete Technology, held in Singapore. The Three-Day International Symposium on Sustainable Development and Concrete Technology to have been held in mid-September 2001 in San Francisco was cancelled.

In 2003, the Committee for the Organization of CANMET/ACI Conferences, the National Research Council's Institute for Research in Construction, and others are planning three international conferences relating to cement and concrete. These are: 1) the Sixth CANMET/ACI International Conference on Durability of Concrete to be held in Thessaloniki, Greece, on June 1-7, 2003; 2) the Sixth CANMET/ACI International Conference on Recent Advances in Concrete Technology to be held in Bucharest, Romania, on June 8-11, 2003; and 3) the Seventh CANMET/ACI International Conference on Superplasticizers and Other Chemical Admixtures in Concrete to be held in Berlin, Germany, on October 20-24, 2003.

Research efforts to develop new superplasticizers for use in conjunction with SCMs for high-performance concrete have increased in recent years. As a result of this, a publication entitled *Superplasticizers: Properties and Applications in Concrete*, by Ramachandran, Malhotra, Jolicoeur and Spiratos, was compiled to integrate the chemistry and applications concerned. This publication, which includes 14 chapters and more than 400 pages, can be obtained from the Materials Technology Laboratory (MTL) of NRCan's CANMET by contacting Alan Bowles by telephone at (613) 995-8814 or by e-mail at abowles@nrcan.gc.ca.

NRCan, mainly in collaboration with the Canadian Industry Program for Energy Conservation (CIPEC), continued to develop long-term strategies related to major energy-consuming sectors.

OUTLOOK

Cement shipments in 2002 are expected to be higher based on continued strength in the housing sector, relatively low interest rates, and growth in exports to the United States. Expenditures continued under the Infrastructure Canada Program involving federal, provincial/territorial and municipal governments. This program is expected to contribute about $6 billion relating to both building and engineering infrastructure during the six-year period, including 2005.

Housing starts were about 163 000 in 2001, according to the Canada Mortgage and Housing Corporation. By way of comparison, housing starts were about 150 000 in 1999 and 152 000 in 2000. (Additional information relating to residential construction can be obtained on the Internet at www.cmhc-schl.gc.ca/cmhc.html.) Non-residential construction and industrial construction permits are expected to be weaker in 2002 based on trends early in the year.

Energy management in the cement industry will continue to concentrate on gains in efficiency based on timely switching among the available choices of common fuels. However, most longer-term cost savings are expected to result from the partial substitution of fossil fuels by waste-derived fuels. For example, in selected regions, in the case of Refuse Derived Fuel (RDF), about 70% (by volume) of municipal solid waste from post-recycled curbside garbage could be extracted for use by the cement industry. This would reduce by about two thirds the volume of material for disposal as landfill. Under certain circumstances using RDF, reductions in requirements for traditional fuels have been predicted to be as high as 20-25%.

World production and use of cement in 2001 was 1.7 billion t, according to the U.S. Geological Survey (USGS). These amounts are forecast to be about 1.9 billion t and 2.1 billion t in 2005 and 2010, respectively, according to a report by Ocean Shipping Consultants Ltd. Of the overall forecasted 500-Mt increase, accepting the 1999 base-year amount of 1.6 billion t by the USGS, Asia is expected to account for more than 60%, Africa and the Middle East for 13%, and Central and South America for about 10%.

The use of supplementary cementing materials incorporating fly ash, silica fume or other pozzolanic materials such as ground, granulated slags as a partial replacement for energy-intensive Portland cement is expected to become more important in modern cement and concrete practices. An estimated 35-40 Mt of these products are currently used as a raw material or as partial replacement for Portland cement in North America and western Europe.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 1, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
25.23	Portland cement, aluminous cement, slag cement, supersulphate cement and similar hydraulic cements, whether or not coloured or in the form of clinkers				
2523.10	Cement clinkers	Free	Free	Free	Free
	Portland cement:				
2523.21	White cement, whether or not artificially coloured	Free	Free	Free	Free
2523.29	Other	Free	Free	Free	Free
2523.30	Aluminous cement	Free	Free	Free	Free
2523.90	Other hydraulic cements	Free	Free	Free	Free
68.10	Articles of cement, of concrete or of artificial stone, whether or not reinforced				
	Tiles, flagstones, bricks and similar articles:				
6810.11	Building blocks and bricks	3%	Free	Free	Free
6810.19	Other	5%	Free	Free	Free
6810.91	Prefabricated structural components for building or civil engineering	5%	Free	Free	Free
6810.99	Other				
6810.99.10	Pipes	5%	Free	Free	Free
6810.99.90	Other	5%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, CEMENT PRODUCTION AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (1) (all forms)							
	Newfoundland and Labrador	x	x	x	x	–	–
	Nova Scotia	x	x	x	x	x	x
	Quebec	2 842 667	237 306	2 830 381	240 549	2 888 331	248 858
	Ontario	5 548 561	511 200	5 344 406	507 182	5 695 905	546 349
	Alberta	(r) x	(r) x	x	x	x	x
	British Columbia	1 643 184	168 090	1 919 187	201 443	2 111 380	232 581
	Total	(r) 12 624 924	(r)1 230 972	12 611 954	1 256 697	12 985 521	1 312 450
IMPORTS (2)							
2523.10	Cement clinker						
	Turkey	–	–	163 339	6 848	245 399	8 679
	Cyprus	–	–	–	–	1 500	95
	United States	331	14	624	25	39	2
	Spain	23 693	1 126	62 522	2 868	–	–
	Lebanon	190 365	8 841	–	–	–	–
	Mexico	7 991	355	5 539	247	–	–
	Switzerland	–	–	34 629	2 088	–	–
	United Arab Emirates	–	–	95 951	5 086	–	–
	Total	222 380	10 336	362 604	17 162	246 938	8 776
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	13 403	2 716	14 059	3 049	10 092	1 447
	Denmark	3 059	421	5 157	715	3 165	469
	Netherlands	–	–	–	–	291	42
	Mexico	38 784	3 736	1 141	216	20	6
	Bermuda	19 380	877	–	–	–	–
	Other countries	6	1	81	14	150	33
	Total	74 632	7 751	20 438	3 994	13 718	1 997
2523.29	Portland cement, n.e.s.						
	United States	455 956	37 001	506 007	42 177	554 710	47 040
	Venezuela	–	–	–	–	13 097	1 338
	Mexico	578	45	593	54	12 586	1 324
	United Kingdom	–	–	570	55	1 013	65
	France	244	25	2	...	654	53
	Croatia	781	61	–	–	138	13
	Canada	–	–	–	–	105	8
	Other countries	58	4	145	12	30	2
	Total	457 617	37 136	507 317	42 298	582 333	49 843
2523.30	Aluminous cement						
	United States	13 662	7 999	12 581	7 700	9 670	6 485
	Croatia	185	91	1 689	1 014	2 501	1 635
	Other countries	46	25	1	...	5	1
	Total	13 893	8 115	14 271	8 714	12 176	8 121
2523.90	Hydraulic cement, n.e.s.						
	United States	57 737	6 844	56 784	6 368	69 549	7 711
	Turkey	–	–	–	–	41 825	3 150
	China	14 374	1 515	19 927	2 071	20 588	2 189
	Belgium	5	1	17 867	1 987	11 851	1 149
	United Kingdom	2 360	494	3 098	597	3 029	703
	Croatia	148	35	692	131	1 270	254
	Germany	6	...	161	43	521	154
	India	–	–	–	–	652	114
	Switzerland	–	–	30	4	642	64
	Bahrain	–	–	–	–	144	33
	Thailand	–	–	–	–	274	29
	France	564	110	447	77	52	13
	Sweden	–	–	152	48	57	10
	Japan	693	159	356	106	13	4
	South Africa	–	–	199	44	–	–
	Costa Rica	–	–	140	31	–	–
	Other countries	153	31	60	15	157	35
	Total	76 040	9 189	99 913	11 524	150 624	15 612
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	..	3 632	..	2 931	..	2 914
	Brazil	..	126	..	219	..	372
	Other countries	..	38	..	48	..	66
	Total	..	3 796	..	3 198	..	3 352

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	..	15 119	..	17 020	..	19 216
	Italy	..	978	..	1 105	..	1 441
	Mexico	..	29	..	24	..	704
	Spain	..	109	..	205	..	140
	Portugal	..	91	..	139	..	133
	China	..	15	..	41	..	52
	Belgium	–	–	–	–	..	31
	Other countries	..	176	..	128	..	30
	Total	..	16 517	..	18 662	..	21 747
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	..	3 177	..	2 507	..	4 566
	Netherlands	..	6	–	–	..	52
	United Kingdom	..	503	–	–	–	–
	Other countries	..	8	..	1	..	1
	Total	..	3 694	..	2 508	..	4 619
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	..	(r) 17 207	..	19 840	..	17 547
	China	..	(r) 3 814	..	6 099	..	6 420
	Mexico	..	607	..	933	..	649
	Belgium	–	–	..	687	..	632
	United Kingdom	..	742	..	788	..	392
	Spain	..	28	..	54	..	299
	Germany	..	71	..	208	..	148
	Italy	..	222	..	164	..	115
	Philippines	..	264	..	64	..	71
	Canada	..	17	..	43	..	48
	France	..	6	..	5	..	43
	Taiwan	..	70	..	55	..	43
	Indonesia	..	6	..	75	..	43
	Thailand	..	13	..	12	..	32
	South Africa	..	25	..	18	..	31
	Hong Kong	..	187	..	28	..	11
	South Korea	..	(r) 148	..	224	..	2
	Malaysia	..	480	..	348	..	2
	Other countries	..	(r) 51	..	90	..	44
	Total	..	(r) 23 958	..	29 735	..	26 572
EXPORTS							
2523.10	Cement clinker						
	United States	1 236 860	87 794	805 870	64 224	660 913	55 591
	Total	1 236 860	87 794	805 870	64 224	660 913	55 591
2523.21	Portland cement, white, whether or not artificially coloured						
	United States	179 837	32 251	180 730	32 480	212 937	40 667
	Other countries	106	34	29	42	–	–
	Total	179 943	32 285	180 759	32 522	212 937	40 667
2523.29	Portland cement, n.e.s.						
	United States	4 083 662	313 797	3 915 840	310 692	4 160 240	349 589
	Singapore	–	–	–	–	18	15
	Sierra Leone	–	–	–	–	10	2
	Iceland	200	23	–	–	–	–
	South Korea	316	24	–	–	–	–
	Other countries	52	13	30	30	–	–
	Total	4 084 230	313 857	3 915 870	310 722	4 160 268	349 606

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2523.30	Aluminous cement	–	–	–	–	–	–
2523.90	Hydraulic cement, n.e.s.						
	United States	22 742	3 594	4 404	2 074	87 759	9 042
	Hong Kong	26	10	20	37	365	96
	Singapore	17	12	23	23	136	59
	Jamaica	74	62	427	217	57	41
	Japan	22	7	16	9	55	39
	France	–	–	–	–	92	29
	Italy	–	–	–	–	102	27
	Chile	105	68	–	–	–	–
	Germany	–	–	161	41	–	–
	Other countries	8	14	139	113	118	83
	Total	22 994	3 767	5 190	2 514	88 684	9 416
6810.11	Building blocks and bricks of cement, concrete or artificial stone						
	United States	. .	53 908	. .	64 997	. .	63 897
	South Africa	–	–	–	–	. .	245
	Italy	. .	24	. .	34	. .	110
	France	–	–	. .	74	. .	101
	Bermuda	–	–	–	–	. .	58
	Japan	. .	234	. .	102	. .	25
	Ukraine	. .	73	. .	217	. .	22
	Other countries	. .	96	. .	28	. .	37
	Total	. .	54 335	. .	65 452	. .	64 495
6810.19	Tiles, flagstones and similar articles of cement/concrete or artificial stone						
	United States	. .	33 415	. .	55 021	. .	56 234
	Turkey	. .	2 501	. .	1 871	. .	1 074
	Japan	. .	1 888	. .	606	. .	299
	Antigua and Barbuda	–	–	–	–	. .	240
	Cuba	. .	11	. .	119	. .	209
	France	–	–	. .	34	. .	128
	Belgium	–	–	. .	131	. .	90
	Australia	. .	1 275	–	–	–	–
	Other countries	. .	99	. .	34	. .	285
	Total	. .	39 169	. .	57 816	. .	58 559
6810.91	Prefabricated structural components of buildings, etc., of cement/concrete, etc.						
	United States	. .	115 800	. .	96 852	. .	129 749
	United Kingdom	–	–	. .	802	. .	2 806
	Bermuda	. .	38	. .	44	. .	285
	Romania	–	–	–	–	. .	172
	Cuba	–	–	. .	28	. .	169
	France	. .	207	. .	252	. .	30
	Australia	–	–	. .	179	–	–
	Venezuela	–	–	. .	192	–	–
	Other countries	. .	83	. .	34	. .	26
	Total	. .	116 128	. .	98 383	. .	133 237
6810.99	Articles of cement, of concrete or of artificial stone, n.e.s.						
	United States	. .	48 593	. .	71 139	. .	69 335
	Cuba	–	–	. .	1 208	. .	430
	France	. .	528	. .	515	. .	226
	Bermuda	–	–	. .	223	. .	211
	Japan	. .	43	. .	83	. .	129
	South Korea	–	–	. .	99	. .	112
	Mexico	–	–	–	–	. .	95
	Norway	–	–	–	–	. .	82
	United Kingdom	. .	1 726	. .	275	–	–
	Belgium	. .	16	. .	279	–	–
	Other countries	. .	50	. .	181	. .	164
	Total	. .	50 956	. .	74 002	. .	70 784

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.a. Not applicable; n.e.s. Not elsewhere specified; (p) Preliminary (r) Revised; x Confidential.
(1) Producers' shipments plus quantities used by producers; (2) Includes re-imports.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CEMENT PLANTS, APPROXIMATE ANNUAL GRINDING CAPACITY, END OF 2000

Company	Plant	Wet (W) Dry (D) Preheater (x) Precalciner (c)	Fuel (Coal, Oil, Gas, Waste)	No. of Kilns	Grinding Capacity	Clinker Capacity
					(000 t/y)	
ATLANTIC REGION						
Lafarge Canada Inc.	Brookfield, N.S.	D	C,Wa	2	536	485
Subtotal, Atlantic region				2	536	485
QUEBEC						
Lafarge Canada Inc.	St. Constant	D	Wa,C,O,G	2	1 129	950
Ciment Québec Inc. (Essroc Corp.)	St. Basile	Dc	C,O,G,Wa	1	1 571	776
St. Lawrence Cement Inc. (Holcim (AG) (1)	Joliette	D	C,Wa	4	1 475	900
Subtotal, Quebec region				7	4 175	2 626
ONTARIO						
Lafarge Canada Inc.	Woodstock	W	C,G	2	775	549
	Bath	Dx	C	1	1 190	1 072
Federal White Cement Ltd.	Woodstock	Dx	O,G	2	460	820
Essroc Canada Inc. (Italcimenti)	Picton	D,Dx	C,G	2	688	1 129
St. Lawrence Cement Inc. (Holcim AG) (1)	Mississauga	W,Dc	C,O,Wa	3	2 009	(a) 1 883
Blue Circle Canada Inc. (2)	Bowmanville	Dc	C	1	1 464	1 844
	St. Marys	Dx	C,Wa	1	685	738
Subtotal, Ontario region				12	7 271	8 035
PRAIRIE REGION						
Lafarge Canada Inc.	Exshaw, Alta.	D,Dc	G	2	1 459	1 194
Inland Cement Limited (3) (Heidelberger Cement)	Edmonton, Alta.	Dc	G	1	1 380	961
Subtotal, Prairie region				3	2 839	2 155
BRITISH COLUMBIA						
Lafarge Canada Inc.	Kamloops	D	C,G	1	344	194
	Richmond	Dc	C,G	1	1 390	1 034
Tilbury Cement Limited (4) (Heidelberger Cement)	Delta	Dx	C,O,G,Wa	1	1 050	1 134
Subtotal, B.C. region				3	2 784	2 362
Total Canada (7 companies, based on ownership)				27	17 605	15 663

Source: Market and Economic Research Department, Portland Cement Association.

(a) Two kilns inacti

(1) Name changed in 2001 from Holderbank Financiere Glaris (Switzerland) AG. (2) Name changed to St. Marys Cement Co. in 2001, with ownership by Votorantim Group, Brazil. (3) Name changed in February 2002 to Lehigh Inland. (4) Name changed in February 2002 to Lehigh Northwest.

Note: Total active kiln capacity including white cement is approximately 15.1 Mt/y.

TABLE 3. CANADA, CEMENT PLANTS, KILNS AND CAPACITY UTILIZATION, 1980-2001

	Clinker-Producing Plants	Kilns (a)	Approximate Cement Grinding Capacity	Portland and Masonry Cement Production (1)	Clinker Exports	Approximate Total Production (2)	Capacity Utilization
			(t/y)	(t)	(t)	(t)	(%)
1980	23	47	16 363 000	10 274 000	726 087	11 000 087	67
1981	23	48	16 771 000	10 145 000	524 006	10 669 006	64
1982	23	48	16 771 000	8 418 000	290 329	8 708 329	50
1983	23	49	17 900 000	7 870 878	404 793	8 275 671	46
1984	23	49	17 900 000	9 387 466	440 297	9 827 763	55
1985	23	49	17 900 000	10 192 442	676 596	10 869 038	61
1986	23	49	17 900 000	10 611 223	324 000	10 935 223	61
1987	20	40	16 600 000	12 603 164	767 338	13 370 502	81
1988	20	40	15 506 000	12 349 873	331 796	12 681 669	82
1989	20	38	15 546 000	12 590 637	178 491	12 769 128	82
1990	20	38	16 439 000	11 745 152	460 075	12 205 227	74
1991	20	34	16 262 000	9 372 219	544 870	9 917 089	61
1992	18	34	16 800 000	8 593 399	988 348	9 581 747	57
1993	18	34	16 800 000	9 393 581	882 935	10 276 516	61
1994	18	34	(r) 17 021 000	10 584 414	981 024	11 565 438	68
1995	18	34	(r) 16 157 000	10 440 329	1 329 548	11 769 877	69
1996	18	32	16 252 000	11 587 365	1 252 863	12 840 228	79
1997	17	30	15 856 000	11 736 272	1 019 308	12 755 580	80
1998	17	28	15 837 000	12 124 058	1 657 808	13 781 866	87
1999	17	27	16 269 000	12 634 440	1 236 860	13 871 300	85
2000	16	27	17 605 000	12 611 954	805 870	13 417 824	76
2001 (p)	16	27	17 605 000	12 986 000	660 900	13 646 900	78

Sources: Statistics Canada; Portland Cement Association.
(p) Preliminary; (r) Revised.
(a) Includes two inactive kilns beginning in 1992.
(1) Producers' shipments and amounts used by producers. (2) Cement shipments/production plus clinker exports.

TABLE 4. CANADA, PRODUCTION AND USE OF COAL COMBUSTION PRODUCTS (CCPs), 2001[1,2]

	Fly Ash	Bottom Ash	FGD Gypsum	Other (3)	Total CCPs
			(000 tonnes)		
PRODUCTION					
Produced	4 815	1 592	382	111	6 900
Disposed/stored	3 881	1 535	–	111	5 526
Removed from disposal	97	123	–	–	220
USE (DOMESTIC)					
Cement	420	202	–	–	622
Concrete/grout	408	–	–	–	408
Mining applications	145	–	–	–	145
Roadbase/subbase	8	46	–	–	54
Wallboard	–	–	530	–	530
Other (4)	71	12	–	–	84
Total use	1 052	261	530	–	1 843
Individual use percentage	22	16	139	–	n.a.
Cumulative use percentage	22	20	27	27	27

Sources: Compiled by Natural Resources Canada in cooperation with the Canadian Electricity Association and Canadian Industries Recycling Coal Ash (CIRCA).
– Nil; n.a. Not applicable; FGD Flue-gas desulphurization.
(1) Reported production of coal combustion products (CCPs) may include both dry and ponded categories. (2) Use (domestic), as reported, includes amounts imported (assumed HS codes 2621.00 relating to fly ash and HS 2520.10 relating to gypsum). (3) Cfb (circulating fluidized bed) fly ash and bottom ash. (4) Includes waste stabilization and specialty uses such as mineral filler and flowable fill.

TABLE 5. CANADA, VALUE OF CONSTRUCTION BY TYPE, 1996-2001

	1996	1997	1998	1999	2000	2001
			($ billions)			
BUILDING CONSTRUCTION						
Residential investment	32.3	36.5	36.0	38.8	40.8	43.6
Non-residential building investment	19.6	22.5	22.4	24.2	25.3	26.3
Total building construction	51.9	59.0	58.4	63.0	66.1	69.9
ENGINEERING CONSTRUCTION						
Mining and oil and gas extraction	13.9	18.2	16.7	15.4	19.3	21.1
Transportation and warehousing	2.0	2.2	5.0	5.0	4.1	3.4
Other engineering	15.2	14.7	14.5	16.6	18.3	18.9
Total engineering construction	31.1	35.1	36.2	37.0	41.7	43.4
Total all components	83.0	94.1	94.6	100.0	107.8	113.3

Sources: Natural Resources Canada; Statistics Canada, CANSIM II (Table 026-0013 – Residential Values, by Type of Investment and Related Table 031-0002 – Flows and Stocks of Fixed Non-Residential Capital, by North American Industry Classification System). (More information can be obtained on the Internet at the CANSIM II site at www.statcan.ca/english/ads/cansimII.)

Notes: Numbers may not add to totals due to rounding. Residential construction includes value of new construction, renovations and acquisition costs.

TABLE 6. WORLD PRODUCTION OF CEMENT, 2000 AND 2001[(e)]

	2000	2001(e)
	(000 tonnes)	
Canada	12 612	13 000
Brazil	39 208	40 000
China	583 190	595 000
Germany	38 000	40 000
India	95 000	100 000
Italy	36 000	36 000
Japan	81 300	82 000
South Korea	51 255	52 000
Russia	32 400	35 000
Spain	30 000	30 000
Thailand	32 000	32 000
Turkey	35 825	36 000
United States	89 150	91 100
Other countries	459 497	469 500
Total world	1 615 797	1 651 600

Sources: Natural Resources Canada; U.S. Geological Survey, January 2002.

(e) Estimated.

Coal

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Coal is an organically derived material. It is formed from the remains of decayed plant material compacted into a solid through millions of years of chemical changes under pressure and heat. As the organic maturity process continues, the buried plant material is transformed into different kinds of coal. In general, the longer coal is subjected to heat and pressure, the higher its grade and contained heat volume per unit weight. Lignite and subbituminous are low-rank coals, also known as brown coals, consumed only for the generation of electricity. Bituminous coal and anthracite are high-rank coals, also known as hard coal. Bituminous coal is consumed for both metallurgical and thermal purposes. Anthracite, the highest rank coal, is often called smokeless and is consumed for both domestic and industrial purposes.

Coal is the world's most abundant and widely distributed fossil fuel. The current proven world's coal reserve is estimated at 984 211 Mt, spread over 100 countries, and coal is currently mined in more than 50 countries. Canada holds 8623 Mt, less than 1% of the world's reserves. Coal offers a long-term economical source of energy that, at current production levels, would last for more than 200 years, significantly longer than reserves of oil and gas.

Coal has been consumed as an energy source for hundreds of years. It provided the energy that boosted the industrial revolution of the 19th century and launched the electric era in the 20th century. Coal was the most important source of the world's primary energy until the late 1960s when it was overtaken by oil. Today, about 70% of total world coal production is consumed for electricity generation, providing about 37% of total world electricity production. About 20% of Canada's electricity is generated by coal. Almost all primary steel production worldwide is based on pig iron from blast furnaces fed with coke from coal, and iron ore. The recycled steel industry, using recycled iron and steel (i.e., scrap), accounts for about 30% of production. In Canada, the recycled steel industry accounts for close to half of the steel production.

CANADIAN DEVELOPMENTS

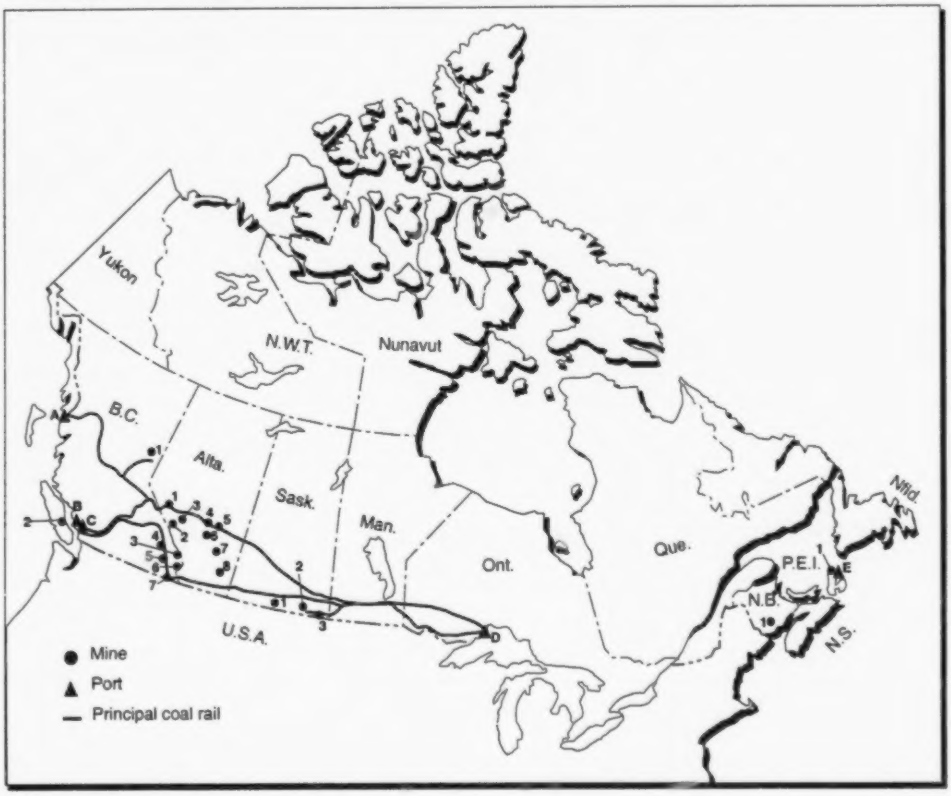
The Canadian coal industry plays an important role in the Canadian economy, both as a mining industry and as an energy provider. In 2001, about 70.4 Mt of coal were produced by 19 major coal mines and the coal industry directly employed approximately 6040 people. Close to half of Canada's coal production was exported, primarily as metallurgical coal.

After some major changes in the Canadian coal industry in the late 1990s, it became more concentrated in terms of ownership and operation. There were 19 major mines in operation at the end of 2001. Two companies, Luscar Ltd. and Fording Coal Limited, currently control and operate 15 of the major coal mines in Canada and account for about 90% of total Canadian coal production.

The largest company, Luscar Ltd., operates 10 mines in the provinces of British Columbia (Line Creek), Alberta (Luscar, Coal Valley, Obed Mountain, Highvale, Paintearth, Sheerness), and Saskatchewan (Poplar River, Boundary Dam, Bienfait). Luscar produces approximately 38 Mt/y. On April 24, 2001, Sherritt Coal Partnership (a partnership of Sherritt International Corporation and a subsidiary of the Ontario Teachers' Pension Plan Board) reached an agreement with the Luscar Coal Income Fund to acquire all outstanding shares of Luscar Ltd. As of June 30, 2001, the Luscar Coal Income Fund was wholly owned by Sherritt Coal and was delisted from the Toronto Stock Exchange (TSE). On September 14, 2001, Sherritt Coal Partnership announced the change of its name to Luscar Energy Partnership (LEP).

The second largest company, Fording Coal Limited, operates five mines in British Columbia (Fording River, Coal Mountain, Greenhills) and Alberta (Whitewood, Genesee). It produces about 22 Mt/y, mainly for export. Fording became an independent, publicly owned company in October 2001 following

Figure 1
Principal Canadian Coal Mines and Ports


Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
A
B
C
D
E
1
2
3
4
5
6
7
8
● Mine
▲ Port
— Principal coal rail

Numbers refer to locations on map above.

MINES

BRITISH COLUMBIA

1. Bullmoose
2. Quinsam
3. Fording River
4. Greenhills
5. Elkview
6. Line Creek
7. Coal Mountain

ALBERTA

1. Obed Mountain
2. Luscar
3. Coal Valley
4. Highvale
5. Whitewood
6. Genesee
7. Paintearth
8. Sheerness

SASKATCHEWAN

1. Poplar River
2. Boundary Dam
3. Bienfait

NEW BRUNSWICK

1. Minto

NOVA SCOTIA

1. Prince

PORTS

BRITISH COLUMBIA

A. Ridley Terminals
B. Neptune
C. Westshore Terminals

ONTARIO

D. Thunder Bay

NOVA SCOTIA

E. International Pier

the reorganization of Canadian Pacific Limited. Fording (FDG) is traded on the Toronto and New York stock exchanges and is included in the TSE 300 Composite Index.

Teck Cominco Limited owns two mines in British Columbia (Elkview and Bullmoose). It produces about 5.5 Mt/y. Other small producers are Quinsam Coal Corporation in British Columbia, owned by Hillsborough Resources Limited, and New Brunswick Coal, a subsidiary of New Brunswick Power Corporation.

There are four new projects that could eventually be part of the Canadian coal industry.

The Cheviot coal mine project, under the ownership of Luscar Ltd. and Consol of Canada Inc., received federal government regulatory approval on April 9, 2001. Cheviot is supposed to replace the Luscar mine when that deposit has been depleted; it is expected to close in 2002. The proposed Cheviot coal project will have a production capacity of about 3.5 Mt/y and employ approximately 500 people. Luscar Ltd. and Consol of Canada have delayed the project due to poor coal market conditions.

The Brooks Power project, under the ownership of Fording Coal Limited, was launched in December 2000. The project, located in Brooks, near Calgary, Alberta, proposes to develop a surface coal mine and a 400-MW coal-fired power plant. The Brooks coal deposit contains 125 Mt of subbituminous coal reserves that can be economically recovered with current surface mining technology. It is expected to provide 44 Mt of coal over a 35-year life. The project received a favourable feasibility evaluation. It is expected to get approval in 2002 when the environmental impact assessment is completed and to proceed to the construction phase soon.

The Wolverine coal project, under the ownership of Western Canadian Coal Corp., was accepted by the B.C. Environmental Assessment Office on December 19, 2001. The project is located in Tumbler Ridge, an historical coal-producing region. Wolverine is expected to produce between 1.5 and 2.0 Mt/y of metallurgical coal, primarily for export, and to employ about 230 miners and 60 additional staff. The project has the advantage of using an existing infrastructure, which includes a deep-sea shipping terminal, a railway network, power supply, and a full-service community. It is scheduled to begin producing coal in late 2003 or early 2004 when the environmental assessment is completed and to continue for 12-15 years.

In October 2001, the Grande Cache Coal Company Inc. (GCC) applied for a mine permit. It has submitted a plan for the Grande Cache coal project, including the No. 7 underground coal mine, the No. 8 surface coal mine, and an existing coal processing plant. The project is located in the Grande Cache area of Alberta where Smoky River Coal Limited had operated its coal mine for over 30 years. GCC is a privately owned Alberta company formed in mid-2000 for the purpose of reactivating coal mining in the Grande Cache area; it focuses on developing a sustainable, long-term mining operation on leases formerly held by Smoky River Coal Limited. The coal reserve is estimated at around 50 Mt and is expected to be mined for about 25 years. The Grande Cache project plans to produce 1.3 Mt/y of metallurgical coal, mainly for export, beginning in late 2002 when the environmental impact assessment is approved.

PRODUCTION

In 2001, Canadian coal production ended a three-year decline. It increased 1.9% from the previous year to finish 2001 at 70.4 Mt. Production climbed 5.2% in British Columbia, where coal mining is export-oriented. Production in the rest of the provinces and territories, where most of the coal is consumed to supply coal-fired power generation stations, remained flat.

From 1997 to 2000, Canadian coal production showed a downward trend. Coal production amounted to 79.7 Mt in 1997 and then fell to 75.4 Mt in 1998, 72.5 Mt in 1999 and 69.2 Mt in 2000. Among the factors contributing to the decline were an oversupplied world coal market, decreased demand for coal due to the downturn in the world economy, the depressed world coal market price, the increasing cost of coal production, and closure of the Cape Breton Development Corporation (the Phalen and Prince mines), the Quintette mine, and the Gregg River mine.

The three major western provinces produced 97% of all Canadian coal. Alberta was Canada's largest coal-producing province with a production level of 6 Mt of bituminous coal and 25 Mt of subbituminous coal in 2001. British Columbia was the second largest coal-producing province at about 27 Mt of bituminous coal in 2001, mainly metallurgical coal for export. Saskatchewan was the third largest coal-producing province at about 11.4 Mt of low-rank lignite coal in 2001, all for thermal power generation. New Brunswick produced 165 000 t of thermal coal in 2001, exclusively consumed by New Brunswick Power Corporation to generate electricity. With the closure of Cape Breton Development Corporation, Nova Scotia's coal production declined significantly. A number of small mines produced thermal coal to bring total Nova Scotia production to 1.1 Mt in 2001.

CONSUMPTION

Canadian coal consumption increased constantly from 58 Mt in 1998 to 62.5 Mt in 2001. About 90% of the coal is consumed to generate electricity by 25 coal-fired generation plants across Canada. The remaining 10% is consumed by the steel industry. Alberta, the largest coal-consuming province, consumed about 25.5 Mt in 2001, accounting for 40% of total consumption. Ontario is the second largest coal-consuming province with more than 19 Mt consumed in 2001. With no coal mines in the province, Ontario relies largely on U.S. imports, which amounted to about 15 Mt in 2001, and the remainder came from Alberta and Saskatchewan. Saskatchewan's coal consumption is quite steady at about 9 Mt/y to generate electricity, followed by Nova Scotia at 3.3 Mt/y and New Brunswick at 1.4 Mt/y. The other provinces and territories consume a small amount of coal to generate electricity.

TRADE

Coal export is vital to the Canadian coal industry; about half of Canada's coal production is exported. British Columbia was the most important province for Canadian coal exports at 25 Mt in 2001, while Alberta exported the rest (5 Mt). Canada is a leading provider of metallurgical coal to the world market.

Canada's coal exports were on a downward trend, from 34 Mt in 1998 to 30 Mt in 2001, sliding from the fifth largest exporter position to the seventh largest. This was a direct result of weaker demand for both metallurgical and thermal coal in the Japanese market. The decline was also due to an oversupply of coal on the world market, a dramatic increase in exports from China, and higher exports from South Africa, Russia, Indonesia and Colombia.

Japan still remains the main destination of Canada's coal exports at 10.7 Mt, about 35% of Canada's total in 2001. South Korea was the second largest destination, accounting for 5.3 Mt in 2001. Canada's exports to these two countries are mainly metallurgical coal consumed by the steel industry. The other destinations were Brazil, the United States, Taiwan, Italy and the United Kingdom.

Canada's coal imports have shown an increasing trend, amounting to 18.7 Mt in 1998, 19 Mt in 1999, 21.5 Mt in 2000 and 23.6 Mt in 2001. This was due to the high demand from coal-fired electric power generating stations. Most of the coal imports for Ontario and Nova Scotia are consumed to generate electricity. A small portion is consumed by the Ontario steel industry. Bituminous coal was the traditional import; however, subbituminous coal imports were on the rise from 2.2 Mt in 1998 to 6.0 Mt in 2001. Ontario was the major importer while Saskatchewan imported a small amount. Most imports came from the United States and the remainder came from Colombia, South Africa, China, Venezuela and Russia.

CANADIAN COAL INDUSTRY OUTLOOK

Canada's coal supply is expected to remain at the 2000 level (91 Mt/y) through to 2005. It is then expected to increase slightly from 92 Mt/y to 95 Mt/y between 2005 and 2010, depending on economic conditions.

Coal production is expected to be at a level similar to 2001 (70 Mt/y) for the next few years. It is also expected that at least two of the four new projects will produce coal by 2005. This will slightly increase total production after 2005 to between 79 and 80 Mt/y by 2010. Coal imports are expected to increase slightly every year from 2002 to 2005 due to the growing demand for electricity.

Total demand is expected to remain at the 2000 level for a few years. Domestic consumption is expected to increase, but exports are expected to stay flat. Although world coal trade is expected to grow, the oversupplied world coal market (especially the new force, China), the declined world coal price and the high production cost in Canada will put Canada's coal industry in a difficult position to compete in the world market or to penetrate new markets.

In 2001, there were some new developments in the world coal market. For the first time in four years, Japanese contract prices turned upwards. The hard coking coal price increased by 7.5% and the price of thermal coal rose 20%.

ENVIRONMENT

Environmental concerns with respect to the coal industry include the generation of carbon dioxide and nitrogen oxides and the production of fly ash. The Canadian government commitment to environmental protection has been demonstrated through the signing of several international protocols with commitments to reduce emissions of sulphur dioxide (1985 Helsinki and 1994 Oslo), nitrogen oxide (1998 Sofia) and carbon dioxide (1997 Kyoto). The federal government is consulting with the provinces/territories and industries before ratifying the Kyoto agreement.

New coal mines and expansions are required to have environmental assessments under provincial legislation and, in some cases, also need a federal environmental review under the *Canadian Environmental Assessment Act*. Environmental assessments ensure that mining activities, such as the removal of vegetation, relocation of overburden, construction of roads, reclamation of previous mined areas, and mining operations, have minimal negative effect on the environment. Several Canadian mining companies have already been recognized for their successful environmental management programs.

The Canadian government has also supported Clean Coal Technology (CCT), defined as technology designed to enhance both the efficiency and the environmental acceptability of coal extraction, preparation and consumption. The technology will reduce emissions, reduce waste, and increase the amount of energy gained from each tonne of coal. The technology will enable coal consumption to be increasingly efficient and environmentally acceptable as a vital world energy source throughout the next century.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of May 1, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TABLE 1. COAL SUPPLY AND DEMAND, 1990-2001

	Production	Imports	Total Supply	Exports	Domestic Consumption	Total Demand	Stock Changes
				(000 tonnes)			
1990	68 331	14 113	82 444	31 009	49 040	80 049	2 395
1991	71 138	12 417	83 555	34 112	50 310	84 422	-867
1992	65 610	12 834	78 444	28 097	51 872	79 969	-1 525
1993	69 027	8 392	77 419	28 313	49 255	77 568	-149
1994	72 823	9 176	81 999	31 746	52 348	84 094	-2 095
1995	74 967	9 684	84 651	33 992	52 773	86 765	-2 114
1996	75 851	12 025	87 876	34 459	53 514	87 973	-97
1997	78 693	13 480	92 173	36 182	55 702	91 884	289
1998	75 360	18 675	94 035	34 183	59 106	93 289	746
1999	72 497	19 078	91 575	33 743	58 077	91 820	-245
2000	69 163	21 834	90 997	31 735	60 895	92 630	-1 633
2001	70 361	23 629	93 990	30 145	60 421	90 566	3 424

Sources: Natural Resources Canada; Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 2. COAL DISPOSITION FROM MINES, 2001

	Nova Scotia	New Brunswick	Saskatchewan	Alberta	British Columbia	Canada
			(000 tonnes)			
DELIVERIES TO:						
Newfoundland and Labrador	–	–	–	–	–	–
Prince Edward Island	–	–	–	–	–	–
Nova Scotia	1 082	–	–	–	–	1082
New Brunswick	–	165	–	–	–	165
Quebec	–	–	–	–	–	–
Ontario	–	–	1 781	425	215	2 421
Manitoba	–	–	76	–	–	76
Saskatchewan	–	–	9 484	–	–	9 484
Alberta	–	–	–	25 031	–	25 031
British Columbia	–	–	–	367	920	1 287
Total ports	–	–	–	4 725	24 500	29 225
United States	–	–	–	22	1 568	1 590
Total	1 082	165	11 341	30 570	27 203	70 361

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 3. COAL SUPPLY BY RANK, 1990-2001

	Production				Imports				
	Bituminous	Sub-bituminous	Lignite	Total	Anthracite	Bituminous	Sub-bituminous	Total	Total Supply
					(million tonnes)				
1990	37.6	21.3	9.4	68.3	0.3	13.8	. .	14.1	82.4
1991	39.9	22.2	9.0	71.1	0.2	12.2	. .	12.4	83.6
1992	32.6	23.0	10.0	65.6	0.2	12.6	. .	12.8	78.4
1993	35.3	23.7	10.0	69.0	0.3	8.1	. .	8.4	77.4
1994	36.6	25.5	10.7	72.8	0.3	8.9	. .	9.2	82.0
1995	38.6	25.6	10.7	75.0	0.4	9.3	. .	9.7	84.7
1996	40.0	25.0	10.8	75.9	0.5	11.6	. .	12.0	87.9
1997	41.3	25.8	11.7	78.7	0.4	13.0	. .	13.5	92.2
1998	38.3	25.3	11.8	75.4	0.6	15.9	2.2	18.7	94.0
1999	36.5	24.3	11.7	72.5	0.5	15.2	3.4	19.1	91.6
2000	33.8	24.2	11.2	69.2	0.5	16.9	4.4	21.8	91.0
2001	34.1	24.9	11.4	70.4	0.4	17.3	6.0	23.6	93.9

Sources: Natural Resources Canada; Statistics Canada.
. . Not available.
Note: Numbers may not add to totals due to rounding.

TABLE 4. COAL SUPPLY BY RANK AND SOURCE, 1995-2001

	1995	1996	1997	1998	1999	2000	2001
				(000 tonnes)			
DOMESTIC							
Bituminous							
Nova Scotia	2 470	3 170	2 633	2 119	1 538	1 166	1 082
New Brunswick	263	272	171	272	252	229	165
Alberta	11 523	11 164	10 561	11 093	9 904	6 728	5 773
British Columbia	24 350	25 420	27 893	24 800	24 845	25 681	27 000
Subtotal	38 606	40 027	41 257	38 284	36 538	33 804	34 020
Subbituminous							
Alberta	25 622	24 986	25 783	25 285	24 300	24 169	25 000
Lignite							
Saskatchewan	10 740	10 839	11 653	11 790	11 659	11 190	11 341
Total domestic	74 967	75 851	78 693	75 360	72 497	69 163	70 361
IMPORTED							
Anthracite	397	461	435	603	458	526	339
Bituminous	9 286	11 564	13 045	15 909	15 183	16 868	17 300
Subbituminous	–	–	–	2 163	3 438	4 441	5 990
Total imported	9 684	12 025	13 480	18 675	19 078	21 834	23 629
Total supply	84 651	87 876	92 173	94 035	91 575	90 997	93 990

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 5. EXPORTS OF CANADIAN COAL BY TYPE AND DESTINATION, 1998-2001

Country	1998			1999			2000			2001		
	Metallurgical	Thermal	Total	Metallurgical	Thermal	Total	Metallurgical	Thermal	Total	Metallurgical	Thermal	Total
						(000 tonnes)						
Japan	13 308	2 509	15 817	13 990	1 920	15 910	12 086	1 244	13 330	10 407	311	10 718
South Korea	5 305	1 413	6 718	4 103	1 281	5 384	3 851	1 407	5 258	3 496	1 791	5 287
United States	890	114	1 004	517	232	749	540	108	648	419	36	455
Netherlands	722	114	836	281	–	281	408	–	408	265	–	265
Brazil	1 019	126	1 145	1 200	31	1 231	1 472	2	1 474	1 807	–	1 807
Italy	754	107	861	1 035	3	1 038	1 170	14	1 184	1 087	9	1 096
United Kingdom	1 465	62	1 527	1 195	268	1 463	1 094	80	1 174	2 016	–	2 016
Germany	742	–	742	895	114	1 009	792	55	847	1 214	–	1 214
Taiwan	729	120	849	898	–	898	1 324	–	1 324	1 142	–	1 142
Turkey	463	121	584	803	–	803	818	–	818	782	–	782
Chile	293	110	403	301	967	1 268	312	687	999	307	720	1 027
France	399	54	453	703	–	703	585	–	585	503	–	503
Mexico	163	41	204	374	–	374	385	–	385	416	74	490
Belgium	533	56	589	428	–	428	374	151	525	570	–	570
Spain	245	53	298	458	–	458	338	–	338	173	–	173
Others	1 330	823	2 153	1 653	92	1 745	2 310	128	2 438	2 479	120	2 599
Total exports	28 348	5 835	34 183	28 834	4 908	33 743	27 859	3 876	31 735	27 083	3 061	30 145

Sources: Natural Resources Canada; Statistics Canada.
– Nil.
Note: Numbers may not add to totals due to rounding.

TABLE 6. COAL CONSUMPTION BY THERMAL POWER STATIONS, 1990-2001

	Nova Scotia	New Brunswick	Ontario	Manitoba	Saskatchewan	Alberta	Total Canada
				(000 tonnes)			
1990	2 184	496	10 362	298	7 462	21 340	42 142
1991	2 290	426	10 850	232	7 548	22 480	43 846
1992	2 344	471	10 022	233	8 419	23 752	45 453
1993	2 416	506	7 004	178	8 428	24 194	43 002
1994	2 672	1 208	5 170	164	8 502	28 207	45 923
1995	2 578	1 304	6 707	117	9 597	26 201	46 504
1996	2 864	1 370	6 984	176	9 719	25 794	46 906
1997	2 986	1 327	9 012	106	9 820	26 258	49 505
1998	2 597	1 433	12 342	546	9 795	25 963	52 677
1999	2 868	1 379	12 151	303	9 844	25 171	51 717
2000	3 322	1 242	15 209	561	9 180	24 768	54 284
2001	3 350	1 404	14 250	273	9 436	25 430	54 143

Sources: Natural Resources Canada; Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 7. COAL DEMAND, 1990-2001

	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001
						(000 tonnes)						
THERMAL ELECTRIC												
Canadian												
Bituminous	5 821	5 500	5 880	5 357	5 448	4 976	4 888	4 323	3 362	3 516	1 911	2 076
Subbitiminous	20 862	22 071	23 156	23 652	27 154	25 796	25 413	25 856	25 343	24 313	24 149	24 919
Lignite	9 088	8 849	9 576	9 711	9 415	10 517	10 959	11 290	11 686	11 374	10 857	11 130
Total Canadian	35 771	36 420	38 612	38 720	42 017	41 289	41 260	41 469	40 391	39 203	36 918	38 125
Imported												
Bituminous	6 371	7 426	6 841	4 282	3 906	5 215	5 646	8 036	10 136	10 245	12 363	11 071
Subbitiminous	. .	. .	. .	. .	. .	. .	. .	. .	2 397	2 269	5 004	4 947
Total imported	6 371	7 426	6 841	4 282	3 906	5 215	5 646	8 036	12 533	12 514	17 367	16 018
Total thermal	42 142	43 846	45 453	43 002	45 923	46 504	46 906	49 505	52 924	51 717	54 285	54 143
OTHER INDUSTRY												
Canadian												
Bituminous	277	285	340	367	289	426	256	247	267	287	375	405
Lignite	275	227	231	301	252	342	514	331	272	221	312	291
Total Canadian	552	512	571	668	541	768	770	578	539	508	687	696
Imported												
Anthracite	342	219	274	231	281	396	462	435	514	458	526	339
Bituminous	1 008	827	688	689	824	916	929	694	1 010	1 034	1 132	987
Total imported	1 350	1 046	962	920	1 105	1 312	1 391	1 129	1 524	1 492	1 658	1 326
Total other industry	1 902	1 558	1 533	1 588	1 646	2 080	2 161	1 707	2 063	2 000	2 345	2 022
METALLURGICAL												
Canadian	. .	. .	. .	. .	227	288	101	. .	27	177	217	204
Imported	4 996	4 906	4 886	4 665	4 552	3 901	4 345	4 490	4 092	4 183	4 048	4 052
Total metallurgical	4 996	4 906	4 886	4 665	4 779	4 189	4 446	4 490	4 119	4 360	4 265	4 256
USE												
Canadian	36 323	36 932	39 183	39 388	42 785	42 346	42 132	42 047	40 957	39 888	37 822	39 025
Imported	12 717	13 378	12 689	9 867	9 563	10 427	11 382	13 655	18 149	18 189	23 073	21 396
Total use	49 040	50 310	51 872	49 255	52 348	52 773	53 514	55 702	59 106	58 077	60 895	60 421
DEMAND												
Total	49 040	50 310	51 872	49 255	52 348	52 773	53 514	55 702	59 106	58 077	60 895	60 421
Canadian exports	31 009	34 112	28 097	28 313	31 746	33 992	34 459	36 182	34 179	33 743	31 735	30 145
Total demand	80 049	84 422	79 969	77 568	84 094	86 765	87 973	91 884	93 285	91 820	92 630	90 566

Sources: Natural Resources Canada; Statistics Canada.
. . Not available.
Note: Numbers may not add to totals due to rounding.

Copper

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The decline in prices that began in the third quarter of 2000 continued through most of 2001. A sharp drop in economic activity in most of the major copper-using regions (the United States, Europe and Asia) led to a corresponding drop in demand for copper. While global growth in demand for copper in 2000 was a very healthy 7.0%, demand in 2001 declined by 6.4%. This compares to an average growth in demand over the past 30 years of 2.3% per year. The supply of refined copper grew by 4.4% in 2001 compared with much lower growth of 1.9% in 2000. These market fundamentals contributed to a large swing in the refined metal balance from a deficit of 508 000 t at the end of 2000 to a surplus of 696 000 t at the end of 2001. The cash settlement price for Grade A copper averaged US$1583/t (US71.8¢/lb) in 2001, 13% below the average price in 2000.

CANADIAN DEVELOPMENTS

Canadian mine production of copper (recoverable copper in concentrate) is expected to total approximately 633 000 t in 2001, nearing the 2000 level of 634 000 t. Mine production in 2002 is forecast to total 606 000 t. The anticipated decline in output is mainly attributable to announced suspensions and/or closures taking effect in 2001 and 2002 (see below). In 2001, Canada ranked sixth in the world in terms of mine production (Table 3). This downward trend in mine production is forecast to continue over the next few years as no new mines are expected to come on stream given the current price profile, while output at existing mines is forecast to decline. The Natural Resources Canada publication entitled *Overview of Trends in Canadian Mineral Exploration, 2001*, provides a thorough analysis of trends in exploration in Canada and is available on the Internet at www.nrcan.gc.ca/mms/efab/invest/exploration/default.html.

Refined copper production is expected to grow by 2.5% to 565 000 t in 2001 and by a further 4.8% to 592 000 t in 2002. The rise in production is attributable to a planned increase in output at Falconbridge Limited's Kidd Creek refinery following completion of an expansion that has raised capacity to 147 000 t/y.

Canadian refined copper use is expected to total 265 000 t in 2001, a 3.3% decline from the 2000 total of 274 000 t (Table 5). Refined use is forecast to increase by 10% to 301 000 t in 2002. The expected rise in demand stems from growing demand for power cable and building wire coming from the oil and gas and pulp and paper industries, strong demand for use in new housing construction, and an incremental expansion at Nexan's wire rod facility in Montréal-Est.

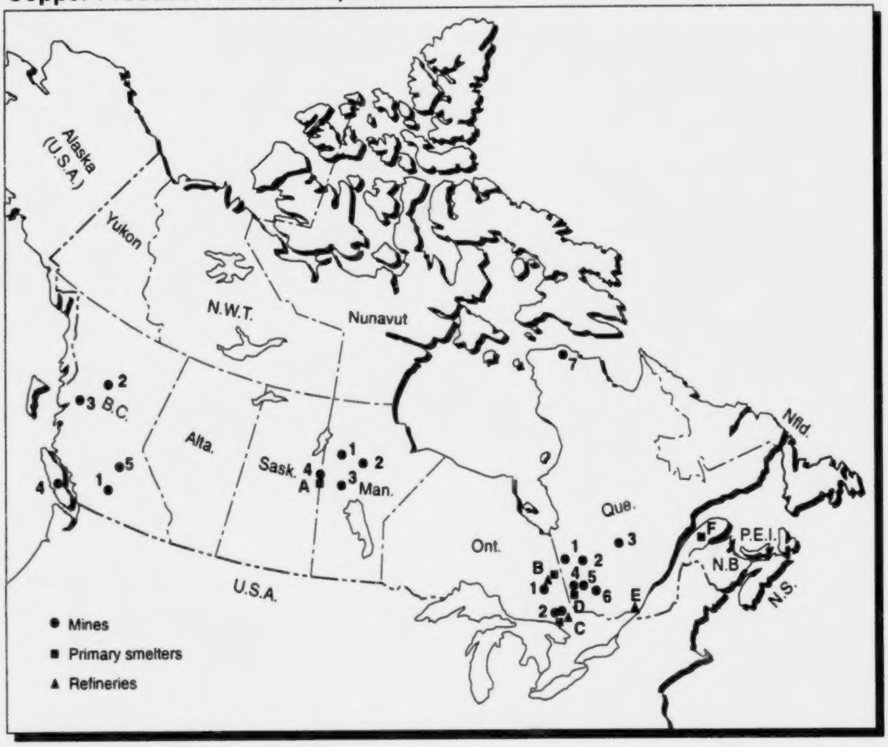
- In April, Teck Corporation and Cominco Ltd. announced that the two companies would merge. Teck Cominco Limited was formed in July and ranks as the fourth largest North American-based base-metal mining and refining company. The merged companies' copper assets include a 64% interest in the Highland Valley Copper mine in British Columbia, a 25% interest in the Louvicourt mine in Quebec, and a 22.5% interest in the Antamina zinc-copper mine in Peru.

- In July 2001, Imperial Metals Corporation announced plans to suspend production at its Mount Polley copper-gold operations in British Columbia on September 30, 2001, due to low metal prices.

- In October 2001, Hudson Bay Mining and Smelting Co., Limited announced it will permanently close the Ruttan zinc-copper mine in northern Manitoba no later than May 2002. Low metal prices, a slowing world economy and a poor economic outlook were the reasons cited for the closure. The Ruttan mine produces approximately 13 500 t/y of copper in concentrate.

- Also in October 2001, Boliden AB announced a three-month suspension of production at its Myra Falls zinc-copper mine in British Columbia beginning on December 3 in response to low metal prices. The mine produces 15 000 t/y of copper in concentrate.

Figure 1
Copper Producers in Canada, 2001



Numbers refer to locations on map above.

MINES

British Columbia
1. Highland Valley Copper
2. Northgate Exploration Limited (Kemess)
3. Imperial Metals Corporation (Huckleberry)
4. Boliden Limited (Myra Falls)
5. Imperial Metals Corporation (Mount Polley)

Saskatchewan
Hudson Bay Mining and Smelting Co., Limited (Flin Flon)

Manitoba
1. Hudson Bay Mining and Smelting Co., Limited (Ruttan mine)
2. Inco Limited (Thompson mine)
3. Hudson Bay Mining and Smelting Co., Limited (Chisel Lake North mine)
4. Hudson Bay Mining and Smelting Co., Limited (Flin Flon area mines including Konuto Lake)

Ontario
1. Falconbridge Limited (Timmins)
2. Falconbridge Limited (Sudbury area)
   Inco Limited (Sudbury area)

Quebec
1. Les Mines Selbaie (Billiton Base Metals)
2. Noranda Inc. (Bell Allard mine)
3. Campbell Resources Inc. (Joe Mann mine)
4. Breakwater Resources Ltd. (Bouchard-Hébert mine)
5. Agnico-Eagle Mines Limited (LaRonde mine)
   Barrick Gold Corporation (Bousquet mine)
6. Aur Resources, Inc., Novicourt Inc., Teck Corporation (Louvicourt mine)
7. Falconbridge Limited (Raglan)

New Brunswick
Noranda Inc. (Brunswick mine)

PRIMARY SMELTERS

A. Hudson Bay Mining and Smelting Co., Limited (Flin Flon)
B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
   Falconbridge Limited (Sudbury area)
D. Noranda Inc. (Noranda)
F. Noranda Inc. (Gaspé)

REFINERIES

B. Falconbridge Limited (Timmins)
C. Inco Limited (Sudbury area)
E. Noranda Inc. (CCR Division)

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1 Highland Valley Copper is a partnership of Teck Cominco Limited and BHP Billiton.

- On November 30, Noranda Inc. announced that it would close its Gaspé copper smelter in Murdochville, Quebec, at the end of April 2002 for a period of at least six months. The announcement indicated that copper production from Noranda's CCR refinery in Montréal-Est, where output from the Gaspé smelter is further processed, would be reduced by 45 000 t/y from its design capacity of 360 000 t/y. Noranda advised that its decision to shut the smelter is in response to weak market conditions, high copper inventories, and metal prices and concentrate treatment charges that are at their lowest levels in 14 years.

A detailed list of copper mines in Canada is available on the Internet at www.nrcan.gc.ca/mms/efab/mmsd/minerals/copper.htm#producers.

WORLD DEVELOPMENTS

World mine production of copper increased by 2.4% to 13.6 Mt in 2001 from 13.2 Mt in 2000 (Table 3). This figure includes some of the many mine production cutbacks announced during 2001. As of the end of December 2001, temporary suspensions or reductions representing over 600 000 t of annual capacity were announced.

MINE CLOSURES/CUTBACKS ANNOUNCED IN 2001

Country	Mine	Event	Quantity (t/y)	Effective Date
Canada	Mount Polley	closure	15 000	October 2001
United States	Chino	closure	66 000	October 2001
United States	Miami	closure	45 000	October 2001
United States	Bagdad	cutback	64 000	October 2001
United States	Sierrita	cutback	45 000	October 2001
Canada	Myra Falls	closure	15 000	December 2001
Sweden	Apirsa	closure	2 500	
Canada	Ruttan	closure	17 500	by May 2003
Chile	El Indio	closure	15 000	by mid-2003
China	Tongling (6 mines)	cutback	15 000	
Zambia	Chibuluma South	closure	15 000	
Chile	Escondida	cutback	80 000	November 2001
Chile	Tintaya	closure	90 000	by January 2003
Chile	Codelco	cutback	100 000	January 2003
Chile	Los Pelambres	cutback	40 000	by January 2003
Total identified			625 000	

During 2001, world production of refined copper (which includes refined copper from both primary and recycled material) increased by 4.4% to 15.4 Mt from 14.8 Mt in 2000 (Table 4). The price decline had a negative effect on copper scrap supplies in 2001. Within the total world production of refined copper, the secondary component fell by 1.5% to 1.9 Mt.

Australia

- In March, London-based Billiton Plc and Australia's BHP Limited announced their intention to merge their operations to form a new company to be known as BHP Billiton. The merged company's assets are valued at approximately US$11 billion and it ranks as the world's fourth largest producer of copper. BHP Billiton's operations in Canada include a 33.6% partnership interest in the Highland Valley Copper (HVC) mine in British Columbia and the wholly owned Selbaie mine located in northwestern Quebec.

Chile

- Total Chilean copper mine production in 2001 was 4.7 Mt, a 3% increase over 2000 production. Chile is the world's largest copper producer and its output accounted for 35% of total world copper mine production in 2000. Approximately two thirds of 2000 output came from private-sector producers, with the remaining one third coming from the Corporacion Nacional del Cobre de Chile (Codelco-Chile), the state-owned copper producer. Planned expansions announced during 2001, anticipated new projects and further exploration should ensure that Chile maintains its dominant position in the world copper industry. These include:

Owner/Project	Comments
Codelco - Chuquicamata mine	Technological upgrade to increase capacity from 630 000 t/y to 750 000 t/y from 2004
Codelco - El Teniente mine	Colon concentrator expansion to increase capacity from 340 000 t/y to 480 000 t/y by 2003
BHP Billiton - Escondida mine	Escondida Phase IV expansion project to increase output from 400 000 t/y to 1.2 Mt/y to be completed by the end of
Codelco/Phelps Dodge - El Abra mine	Project to leach low-grade ores will raise capacity by 35 000 t to 240 000 t/y
Noranda - Altonorte smelter	Expansion from 160 000 to 290 000 t/y of copper anode and blister completed in early 2000
Alliance Copper Ltd. (Codelco/BHP Billiton) - Mansa mine	New SX/EW mine - construction to start in 2002 with first production in 2003; targeted capacity is 20 000 t/y of copper cathode

- In November, BHP Billiton announced it would reduce planned production at the Escondida mine in Chile by 10%, or approximately 80 000 t/y of copper in concentrate, effective at the end of November. The company also announced it would suspend sulphide production at the Tintaya mine, also in Chile, effective January 8, 2002, which represents 90 000 t of the mine's annual output. The company cited the serious decline in demand for copper as the rationale for the production cuts.

Peru

- Owners Noranda Inc., Teck Cominco Limited, BHP Billiton Plc and Mitsubishi Corporation announced that the Antamina copper-zinc project in northern Peru had achieved commercial production in October 2001, more than four months ahead of the original schedule of February 2002.

  At an average annual production at 305 000 t of copper in concentrates, Antamina is the eighth largest copper mine.

United States

- In response to falling copper prices, Arizona-based Phelps Dodge Corporation announced in October a series of production cutbacks and temporary closures at its U.S.-based operations that would result in a 220 000-t/y reduction in copper metal output by mid-January 2002. The reductions comprise a temporary closure of the Chino and Miami mines, a cutback of 50% at the Sierrita and Bagdad mines, and closure of the Chino smelter and Miami refinery.

- In December 2001, Asarco Incorporated announced a 29%, or 95 000-t/y, production cut at its Amarillo, Texas refinery. This follows the closure of the Chemetco smelter, a major source of copper anode to Asarco.

COPPER USAGE

World copper use declined 3.9% to 14.7 Mt in 2001 from 15.3 Mt in 2000 (this includes refined copper from both primary and recycled material). Among the major copper-using countries, usage in 2001 declined dramatically in the United States (-13%), Japan (-15%) and Germany (-13%). The notable exception to this downward trend was China, the second largest copper-using nation, which recorded an increase of 19% year on year (Table 5).

Copper's properties, particularly its high electrical and thermal conductivity, good tensile strength, elevated melting point, non-magnetic properties and resistance to corrosion, make it and its alloys very attractive for electrical transmission, water tubing, castings and heat exchangers. Copper is the most efficient conductor of electrical power, signals and heat of all the industrial metals. In Canada, more than half of the refined copper used annually is for electrical applications, mostly as wire. Copper's surface lustre also makes it attractive for sculpting, jewellery and architectural applications.

According to figures compiled by CRU International Limited, 75% of copper is used in wire and cable, of which two thirds is used in energy cables (power cables, building wire, etc.). The next largest market is magnet wire, used in cars and appliances, which has shown rapid growth in recent years. Twenty-two percent of the copper used annually is manufactured into tube, sheet and rod for use in various applications, including building construction, industrial machinery and equipment, and consumer and general products.
Table 8 presents end-use data for 1999 and 2000 for the United States, collected by the Copper Development Association Inc. (detailed copper use statistics are not collected in Canada).

For more information on the properties and uses of copper, please refer to the Copper Fact Sheet available on the Internet at www.nrcan.gc.ca/mms/efab/mmsd/minerals/copper.htm.

COPPER RECYCLING

According to World Bureau of Metal Statistics data, there were 5 Mt of scrap copper recovered in 2000. Copper scrap recovery includes both the production of recycled refined copper and the direct scrap copper used by manufacturers. The United States is the largest source of scrap copper; it is estimated that the United States recovered 1 455 000 t of scrap copper in 2000. According to annual surveys conducted by Natural Resources Canada, a total of 99 400 t of contained copper in scrap was recovered in Canada in 2000.

The useful service life of copper-containing products is estimated to be 35 years for residential housing, 30 years for electrical plants, 15 years for non-electrical machinery, 10 years in transportation applications, and generally 10 years in other end uses. Due to the long life of many consumer and industrial products containing copper, the calculation of pure recycling rates presents a challenge. The Statistical Committee of the International Copper Study Group (ICSG) is proposing to focus on obtaining more reliable and comprehensive statistics on the production and use of scrap copper. In Canada, Statistics Canada and Natural Resources Canada are working jointly to improve data on metals recycling. New recycling data for the major metals recycled in Canada, including copper, will be available in early 2003 for reference year 2001.

Scrap copper competes directly with primary forms. Smelters and refineries can, to some extent, substitute scrap for concentrate or blister copper. Foundries and other users may use either primary refined copper or scrap. Scrap copper accounts for 35-40% (Table 11) of the raw material input of global refined copper production.

Copper wire is the single most important source of copper scrap. For recovery purposes, scrap copper is segregated into four principal categories: No. 1 copper wire, No. 2 copper wire, No. 3 copper, and copper-bearing scrap. The differentiation between No. 1 and No. 2 copper wire relates to the minimum copper content of the wire. Other major sources of scrap copper include copper tubing, electrical motors and copper sheeting. Copper scrap also arises in the form of residues and can be recovered from metallurgical compounds, metallic dusts, electronic scrap, copper-containing ashes, and copper-containing sludges. Bronze alloys contain varying percentages of copper and tin as their principal elements. They may also contain smaller proportions of both lead and zinc. Brass alloys contain copper and zinc as their principal elements and may also contain smaller proportions of both tin and lead. Brass and bronze scrap arises in forms such as water valves, plumbing fixtures, auto radiators, cast machinery, train brake linings, ship propellers, brass pipes, water condenser tubes, and lighting fixtures.

The recovery of copper from recycled sources can have significant energy savings when compared to the production of primary copper.

REQUIREMENTS TO PRODUCE COPPER FROM VARIOUS SOURCES (PRIMARY = 100)

Copper Source	Energy Requirements
	(%)
No. 1 scrap copper	3
No. 2 scrap copper	14
Copper-bearing scrap	35
Brass and bronze scrap	6

Source: Kusik & Kenahan, *Energy Use Patterns for Metal Recycling*.

STOCKS

Combined copper stocks on the London Metal Exchange (LME), the Commodities Exchange, Inc. (COMEX) and the Shanghai Metal Exchange increased substantially during the year. At the end of December 2001, stocks at the above-mentioned metal exchanges stood at a record high 1 137 000 t, compared to 523 700 t at the end of 2000.

Total copper stocks, including those at producers, merchants, users and exchanges, amounted to 1 785 000 t at the end of 2001, compared to 1 230 800 t at the end of 2000. Figure 2 shows both total copper stocks and prices for the period 1991-2001.

PRICES

Copper prices on the LME averaged US$1578/t (71.6¢/lb) in 2001 (Figure 2) compared to US$1813/t (82.3¢/lb) in 2000.

OUTLOOK

According to the ICSG, world production of refined copper is expected to decline by about 1.8% to 15.16 Mt in 2002 (net of adjustments for primary feed shortages). World refined copper use is expected to increase by 3% in 2002 to 15.18 Mt. Based on these figures, the ICSG, at its 10th General Session in March 2002, projected a small market deficit of 20 000 t for 2002.

Although demand is expected to recover in 2002, the unprecedented level of copper stocks will prevent any significant price recovery until late in 2002 or early 2003. For the full year 2002, prices are forecast to average in the US71¢-72¢/lb range, or US$1565-$1587/t.

The ICSG's preliminary estimate of supply and demand for 2003 forecasts demand growth of 5% compared to supply growth of 3.3% and a correspon-ding metal deficit of 300 000 t. Based on this and other analysts' forecasts, demand growth should outstrip supply growth over the period 2003-05. This could push prices up to the US$0.95-$1.00/lb level (US$2094-$2205/t) during the period 2003-05.

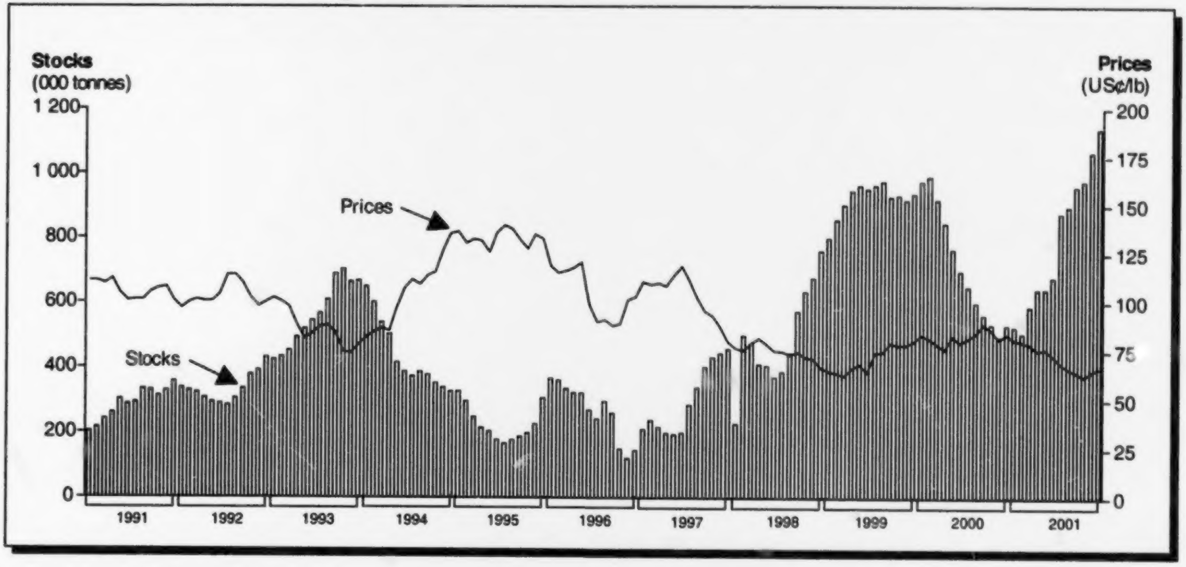
Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of April 30, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 2

Copper Prices[1] and Exchange[2] Stocks, 1991-2001



Source: Natural Resources Canada.

[1] Average monthly LME cash prices. [2] Combined exchange stocks at end of the month.

TARIFFS

Item No.	Description	Canada			United States	EU	Japan (1)
		MFN	GPT	USA	Canada	MFN	WTO
2603.00	Copper ores and concentrates						
2603.00.00.10	Copper content	Free	Free	Free	Free	Free	Free
2825.50	Copper oxides and hydroxides	Free	Free	Free	Free	3.2%	4.8%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
	Other sulphates:						
2833.25	Of copper						
2833.25.10	Cupric sulphate	Free	Free	Free	Free	3.2%	3.9%
2833.25.90	Other copper sulphates	5.5%	Free	Free	Free	3.2%	3.9%
74.01	Copper mattes; cement copper (precipitated copper)						
7401.10	Copper mattes	Free	Free	Free	Free	Free	Free
7401.20	Cement copper (precipitated copper)	Free	Free	Free	Free	Free	Free
7402.00	Unrefined copper; copper anodes for electrolytic refining	Free	Free	Free	Free	Free	Free-3%
74.03	Refined copper and copper alloys,						
	Refined copper:						
7403.11	Cathodes and sections of cathodes	Free	Free	Free	Free	Free	Free-3%
7403.12	Wire bars	Free	Free	Free	Free	Free	Free-3%
7403.13	Billets	Free	Free	Free	Free	Free	Free-3%
7403.19	Other	Free	Free	Free	Free	Free	Free-3%
	Copper alloys:						
7403.21	Copper-zinc base alloys (brass)	Free	Free	Free	Free	Free	Free
7403.22	Copper-tin base alloys (bronze)	Free	Free	Free	Free	Free	Free-3%
7403.23	Copper-nickel base alloys (cupro-nickel) or copper-nickel-zinc base alloys (nickel-silver)	Free	Free	Free	Free	Free	Free-3%
7403.29	Other copper alloys (other than master alloys of heading no. 74.05)	Free	Free	Free	Free	Free	Free-3%
7404.00	Copper waste and scrap	Free	Free	Free	Free	Free	Free
7405.00	Master alloys of copper	Free	Free	Free	Free	Free	3%
74.06	Copper powders and flakes	Free	Free	Free	Free	Free	3%
74.07	Copper bars, rods and profiles of refined copper	Free-3%	Free	Free	Free	4.8%	3%
74.08	Copper wire of refined copper	Free-3%	Free	Free	Free	4.8%	3%
74.09	Copper plates, sheets and strip of a thickness exceeding 0.15 mm	Free	Free	Free	Free	4.8%	3%
74.10	Copper foil (whether or not printed or backed with paper, paperboard, plastics or similar backing materials) of a thickness (excluding any backing) not exceeding 0.15 mm	Free	Free	Free	Free	5.2%	3%
74.11	Copper tubes and pipes	2-2.5%	Free	Free	Free	4.8%	3%
74.12	Copper tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5.2%	Free
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated	3%	Free	Free	Free	Free-5.2%	3%
74.14	Cloth (including endless bands), grill and netting, of copper wire; expanded metal of copper	3%	Free	Free	Free	4.3%	Free
74.15	Nails, tacks, drawing pins, staples (other than those of heading no. 83.05) and similar articles, of copper or of iron or steel with heads of copper; screws, bolts, nuts, screw hooks, rivets, cotters, cotter-pins, washers (including spring washers) and similar articles, of copper	Free-3%	Free	Free	Free	3-4%	Free
7416.00	Copper springs	3%	Free	Free	Free	4%	Free
7417.00	Cooking or heating apparatus of a kind used for domestic purposes, non-electric and parts thereof, of copper	3%	Free	Free	Free	4%	Free
74.18	Table, kitchen or other household articles and parts thereof, of copper; pot scourers and scouring or polishing pads, gloves and the like, of copper; sanitary ware and parts thereof, of copper	3%	Free	Free	Free	3%	Free
74.19	Other articles of copper	Free-9.5%	Free-5%	Free	Free	3%	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001); *Custom Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).

(1) WTO rate is shown; lower tariff rates may apply circumstantially

TABLE 1. CANADA, COPPER PRODUCTION AND TRADE, 2000 AND 2001

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS (1)					
	Newfoundland and Labrador	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	9 423	25 516	8 939	22 240
	Quebec	93 215	252 426	98 220	244 371
	Ontario	199 948	541 459	181 065	450 490
	Manitoba	47 974	129 912	49 312	122 689
	Saskatchewan	642	1 739	748	1 862
	Alberta	–	–	–	–
	British Columbia	270 688	733 024	272 875	678 914
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Total	621 889	1 684 075	611 160	1 520 566
	Refinery output	551 393	. .	564 631	. .
EXPORTS					
2603.00.10	Copper ores and concentrates				
	Copper content				
	Japan	396 578	328 900	382 576	279 052
	China	147 342	113 334	99 178	78 824
	South Korea	54 815	42 738	64 154	49 887
	India	22 176	15 793	21 433	16 754
	Other countries	58 632	46 240	50 662	43 900
	Total	679 543	547 005	618 003	468 417
2604.00.00.10, 2607.00.00.10, 2608.00.00.10, 2616.10.00.10	Other ores and concentrates				
	Copper content				
	Finland	–	–	4 050	2 673
	Total	–	–	4 050	2 673
2620.30	Copper ash and residues				
	United States	. . .	49	43	89
	United Kingdom	3 887	2 462	–	–
	Total	3 887	2 511	43	89
2825.50	Copper oxides and hydroxides	–	–	. . .	1
2833.25	Copper sulphates				
	United States	5 902	7 328	5 601	7 241
	Cuba	–	–	. . .	. . .
	Total	5 902	7 328	5 601	7 241
7401.10	Copper mattes				
	Norway	13 432	31 430	14 940	32 515
	Netherlands	–	–	1 091	2 140
	Other countries	41	15	21	48
	Total	13 473	31 445	16 052	34 703
7401.20	Copper mattes; cement copper (precipitated copper)				
	United States	. . .	17	–	–
	Total	. . .	17	–	–
7402.00	Copper anodes				
	United States	53 807	234 008	80 108	364 768
	Total	53 807	234 008	80 108	364 768

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	United States	267 774	762 729	270 328	706 128
	United Kingdom	13 164	40 602	23 812	64 445
	Netherlands	–	–	8 599	22 179
	Colombia	1 307	5 908	3 747	17 732
	France	3 441	9 400	1 597	4 271
	Dominican Republic	316	1 444	316	1 505
	Cuba	–	–	198	921
	Other countries	2 333	6 567	300	1 395
	Total	288 335	826 650	308 897	818 576
7403.21 to 7403.29	Copper alloys and other copper alloys				
	United States	3 137	8 884	2 737	8 827
	Hong Kong	–	–	6	55
	Other countries	10	46	2	4
	Total	3 147	8 930	2 745	8 886
7404.00	Copper waste and scrap				
	United States	63 475	127 668	56 447	110 866
	China	6 098	8 588	8 539	12 978
	Germany	96	147	1 672	2 997
	India	821	1 074	1 423	2 277
	South Korea	1 206	1 713	594	825
	Netherlands	–	–	433	736
	Japan	311	817	399	713
	Other countries	1 053	1 756	738	1 496
	Total	73 060	141 763	70 245	132 888
7405.00	Master alloys of copper				
	United States	2	7	–	–
	Total	2	7	–	–
7406.10 to 7406.20	Copper powders and flakes				
	Taiwan	29	264	24	259
	United States	46	283	33	237
	Other countries	20	298	19	154
	Total	95	845	76	650
7407.10 to 7407.29	Copper bars, rods and profiles of refined copper				
	United States	9 956	43 687	6 630	29 348
	Chile	252	1 131	161	725
	Other countries	20	96	46	244
	Total	10 228	44 914	6 837	30 317
7408.11 to 7408.29	Copper wire of refined copper and of copper alloys				
	United States	116 427	359 083	112 831	323 017
	Argentina	3	61	4	62
	Other countries	46	514	14	132
	Total	116 476	359 658	112 849	323 211
7409.11 to 7410.22	Copper plates, sheets, strip and foil of refined copper and of copper alloys				
	United States	17 369	133 389	11 278	56 534
	Thailand	787	3 236	964	3 519
	Saudi Arabia	544	2 502	534	2 397
	India	431	1 802	462	1 845
	Jordan	471	2 028	426	1 742
	United Kingdom	681	2 474	444	1 581
	Other countries	2 345	10 202	1 593	6 930
	Total	22 628	155 633	15 701	74 548

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7411.10 to 7411.29	Copper tubes and pipes of refined copper and of copper alloys				
	United States	21 300	116 250	18 203	110 002
	Netherlands	50	333	529	3 307
	United Kingdom	267	2 008	130	984
	Australia	48	353	74	728
	Brazil	–	–	79	656
	Other countries	344	1 963	236	1 508
	Total	22 009	120 907	19 251	117 185
7412.10 to 7412.20	Copper tube and pipe fittings of refined copper and of copper alloys				
	United States	. .	27 491	. .	37 714
	Spain	. .	3 647	. .	3 403
	United Kingdom	. .	2 501	. .	1 633
	Germany	. .	2 337	. .	1 612
	Other countries	. .	4 405	. .	3 941
	Total	. .	40 381	. .	48 303
7413.00	Stranded wire, cables, plaited bands and the like, of copper, not electrically insulated				
	United States	1 049	4 809	1 013	6 012
	Other countries	41	292	20	44
	Total	1 090	5 101	1 033	6 056
7414, 7415, 7416, 7419	Other items of copper				
	United States	. .	38 648	. .	40 292
	Brazil	. .	–	. .	229
	Other countries	. .	509	. .	698
	Total	. .	39 157	. .	41 219
	Total exports		2 566 260		2 479 731
IMPORTS (2)					
2603.00.00.10	Copper ores and concentrates				
	Copper content				
	Chile	103 304	202 662	106 849	206 436
	United States	45 585	98 844	29 468	65 525
	Argentina	17 134	35 465	17 258	36 451
	Peru	–	–	19 516	31 061
	Portugal	12 656	16 924	14 573	23 371
	Indonesia	12 485	25 523	10 109	21 089
	Other countries	20 135	36 938	21 760	44 651
	Total	211 299	416 356	219 533	428 584
2604.00.00.10, 2607.00.00.10, 2608.00.00.10, 2616.10.00.10	Other ores and concentrates				
	Copper content				
	United States	485	792	285	502
	Mexico	130	197	129	246
	Total	615	989	414	748
2620.30	Copper ash and residues				
	United States	13 190	14 097	6 880	9 958
	Sweden	585	1 283	923	1 753
	Germany	19	7	805	455
	Spain	–	–	1 213	339
	Other countries	548	3 559	88	85
	Total	14 342	18 946	9 909	12 590
2825.50	Copper oxides and hydroxides	1 648	4 130	1 390	3 894
2833.25	Copper sulphates	15 379	13 642	19 145	15 888

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
2836.99.90.10	Copper carbonates	. .	1	. .	4
2836.99.90.10	Other copper carbonates	4	10	6	13
	Other cyanides:				
2837.19.00.10	Copper cyanides	49	294	47	298
3212.90.90.12	Pigments based on copper or copper alloy powders and flakes	5	87	19	222
7401.10	Copper mattes	489	2 292	2	6
7401.20	Copper mattes; cement copper (precipitated copper)	1 550	5 845	145	295
7402.00	Copper anodes	11 484	23 909	21 066	41 488
7403.11 to 7403.19	Refined copper and copper alloys, unwrought				
	Refined copper	11 874	34 942	7 993	22 863
7403.21 to 7403.29	Refined copper and copper alloys, unwrought				
	Copper alloy and other copper alloys	11 989	38 088	8 491	29 687
7404.00	Copper waste and scrap				
	United States	85 620	156 076	72 431	128 785
	Chile	1 501	3 301	11 504	29 863
	Sweden	–	–	12 489	14 992
	Germany	223	106	2 976	9 503
	Cuba	1 207	1 970	781	1 346
	United Kingdom	318	602	169	564
	Other countries	3 395	9 001	261	505
	Total	92 264	171 056	100 611	185 558
7405.00	Master alloys of copper	294	1 255	310	1 328
7406.10 to 7406.20	Copper powders and flakes	2 304	12 369	2 042	10 451
7407.10 to	Copper bars, rods and profiles of refined copper				
7407.29	United States	37 092	128 976	30 263	100 616
	Poland	3 024	6 389	2 946	6 155
	South Korea	5 438	7 476	2 023	3 699
	United Kingdom	2 387	7 913	368	2 181
	Germany	294	1 288	284	1 417
	Other countries	4 923	12 537	1 926	5 595
	Total	53 158	164 579	37 810	119 663
7408.11 to 7408.29	Copper wire of refined copper and of copper alloys	29 052	97 393	24 761	82 343
7409.11 to 7409.90, 7410.11 to 7410.22	Copper and copper alloy plates, sheets, strip and foil	49 468	303 501	37 230	211 673
7411.10	Pipes and tubes, refined copper	10 593	48 551	8 135	38 507
7411.21	Pipes and tubes, copper-zinc base alloys	4 325	23 892	4 658	22 887
7411.22	Pipes and tubes, copper-nickel base alloys or copper-nickel-zinc base alloys	392	2 508	413	2 719
7411.29	Plates and tubes, copper alloys, n.e.s.	1 718	10 398	2 339	14 332
7412.10	Fittings, pipe or tube, of refined copper	922	11 300	952	12 293
7412.20	Fittings, pipe or tube, copper alloys	5 575	70 782	5 618	71 862
7413.00	Stranded wire, cable, plaited bands and the like, of copper, not electrically insulated	5 871	24 706	8 359	34 108

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7414.20	Endless bands of copper wire for machinery	. .	245	. .	357
7415.10	Nails, tacks, drawing pins, staples and similar articles of copper or of iron or steel with copper heads	244	1 405	154	913
7415.21	Copper washers, including spring washers	272	1 842	275	1 684
7415.29	Articles of copper, not threaded, n.e.s., similar to those of headings 7415.10 and 7415.21	950	4 567	942	4 986
7415.31	Copper screws, for wood	39	237	19	115
7415.32	Screws, bolts and nuts of copper, excluding wood screws	1 212	6 279	1 223	6 196
7415.39	Articles of copper, threaded, n.e.s., similar to bolts, nuts and screws	842	4 531	703	3 717
7416.00	Copper springs	. .	558	. .	482
7419.10	Chain and parts thereof of copper	62	462	62	391
7419.91	Articles of copper, not further worked than cast, moulded, stamped or forged	10 788	1 366 745	3 296	26 655
7419.99	Articles of copper, n.e.s.	. .	55 541	. .	49 133
	Total imports		2 945 855		1 459 849

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available or not applicable; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary.

(1) Anode copper recovered in Canada from domestic concentrates plus exports of payable copper in concentrate and matte. (2) Imports from "other countries" may include re-imports from Canada.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, COPPER PRODUCTION, TRADE(1) AND USE, 1975, 1980 AND 1985-2001

	Production		Exports			Imports	Use (3)
	Shipments (2)	Refinery Output	Concentrates and Matte	Refined	Total	Refined	Refined
				(tonnes)			
1975	733 826	529 197	314 518	320 705	635 223	10 908	196 106
1980	716 363	505 238	286 076	335 022	621 098	13 466	208 590
1985	738 637	499 626	320 619	280 033	600 652	19 131	222 466
1986	698 527	493 445	341 390	306 822	648 212	20 901	225 586
1987	794 149	491 124	381 126	288 800	669 926	16 583	231 288
1988	758 478	528 723	348 404	268 680	617 084	4 659	236 280
1989	704 432	515 216	348 739	321 690	670 429	4 408	213 046
1990	771 433	515 835	374 875	335 941	710 816	2 611	180 605
1991	780 362	538 339	348 080	377 985	726 065	2 321	159 170
1992	761 694	539 302	346 842	385 761	732 603	8 916	156 132
1993	709 650	561 580	319 840	408 364	728 204	21 155	185 565
1994	590 784	549 869	237 554	388 568	626 122	(r) 19 594	(r) 199 350
1995	700 843	572 616	(r) 274 493	(r) 434 693	(r) 709 186	(r) 24 176	(r) 189 550
1996	652 499	559 200	409 577	384 338	793 915	28 700	218 280
1997	647 779	560 582	515 547	381 476	897 023	22 602	224 777
1998	690 762	562 261	450 867	355 825	806 692	18 685	246 212
1999	581 583	548 563	(r) 355 838	294 106	(r) 649 944	(r) 16 475	(r) 266 505
2000	621 889	551 393	693 016	288 335	981 351	11 874	272 075
2001 (p)	611 160	564 631	638 105	308 897	947 002	7 993	271 455

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary; (r) Revised.

(1) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. (2) From 1975 to 1988, anode copper recovered in Canada from domestic concentrate plus exports of payable copper in concentrates and matte. Starting in 1989 to date, recoverable copper in concentrate shipped.

(3) Producers' domestic shipments of refined copper plus imports of refined shapes.

TABLE 3. WORLD MINE PRODUCTION OF COPPER, 1999-2001

	1999	2000	2001 (p)
		(000 t)	
Chile	4 391	4 602	4 739
United States	1 626	1 467	1 355
Indonesia	786	1 005	1 046
Australia	719	829	873
Peru	536	554	722
Canada	620	634	633
China	520	589	565
Russia	510	525	545
Poland	463	454	475
Kazakhstan	374	430	470
Mexico	381	365	367
Zambia	280	249	312
Papua New Guinea	188	203	204
South Africa	161	148	120
Other	1 628	1 524	1 152
Total	12 742	13 183	13 578

Source: International Copper Study Group.
(p) Preliminary.

TABLE 4. WORLD REFINERY PRODUCTION OF COPPER, 1999-2001

	1999	2000	2001 (p)
		(000 t)	
Chile	2 666	2 668	2 882
United States	2 132	1 794	1 800
China	1 174	1 371	1 427
Japan	1 342	1 437	1 426
Russia	750	816	852
Germany	696	709	694
Canada	549	551	565
Australia	419	487	560
Poland	470	486	498
South Korea	450	468	473
Peru	434	452	462
Belgium/Luxembourg	388	423	424
Kazakhstan	362	395	422
Mexico	427	411	414
Scandinavia	263	273	358
Zambia	268	227	296
Spain	305	314	291
Brazil	193	184	211
Philippines	148	150	162
Other	1 069	1 169	1 222
Total	14 505	14 785	15 439

Source: International Copper Study Group.
(p) Preliminary.

TABLE 5. WORLD REFINED COPPER USE, 1999-2001

	1999	2000	2001 (p)
		(000 t)	
United States	2 995	3 019	2 630
China	1 506	1 879	2 235
Japan	1 293	1 348	1 146
Germany	1 138	1 310	1 141
South Korea	789	861	836
Italy	668	664	674
Taipei, China	655	628	536
Mexico	455	476	411
Brazil	285	333	353
Belgium-Luxembourg	353	347	323
Scandinavia	292	302	309
Spain	255	284	298
India	264	265	290
United Kingdom	300	323	285
Canada	267	274	265
Poland	251	247	264
Russia	158	180	250
Australia	165	168	167
Other	2 163	2 372	2 887
Total	14 252	15 280	15 300

Source: International Copper Study Group.
(p) Preliminary.

TABLE 6. COPPER AND COPPER-NICKEL SMELTERS IN CANADA, 2001

Company and Location	Product	Rated Annual Capacity (1)	Feed Material	Remarks
		(000 tonnes)		
Falconbridge Limited Falconbridge, Ontario	Copper-nickel matte	23	Nickel-copper concentrates	Copper-nickel concentrate processed in fluid bed roasters and an electric furnace; 1800-t/d sulphuric acid plant treats roaster gases. Matte from the smelter is refined in Norway.
Inco Limited Sudbury, Ontario	Molten "blister" copper, nickel sulphide and nickel sinter for the company's refineries; nickel oxide sinter for market, soluble nickel oxide for market	135	Bulk nickel-copper concentrates, scrap	Oxygen flash-smelting of copper sulphide concentrate. Copper converters produce blister copper. Oxygen flash furnace for smelting of nickel-copper concentrate; converters for production of nickel-copper Bessemer matte. Production of matte followed by matte treatment, flotation, separation of copper and nickel sulphides, then by roasting to make nickel oxides for refining and marketing. Oxygen flash conversion of copper sulphide to semi-blister followed by pyrorefining to blister copper.
Falconbridge Limited Timmins, Ontario	Molten "blister" copper	140	Copper concentrates, scrap	Mitsubishi-type smelting, separation and converting furnaces. Hazelett continuous cast anodes. Incremental expansion increased capacity to 140 000 t/y in 1999.
Noranda Inc. Horne smelter Rouyn-Noranda, Quebec	Copper anodes	200	Copper concentrates, scrap	New continuous converter commissioned in 1997.
Noranda Inc. Gaspé smelter Murdochville, Quebec	Copper anodes	135	Copper concentrates	Green charge reverberatory furnace, three converters, one rotary anode furnace and an acid plant.
Hudson Bay Mining and Smelting Co., Limited (HBMS) Flin Flon, Manitoba	Copper anodes	90	Copper concentrates	Five roasting furnaces, one reverberatory furnace and two converters. Modernization planned but delayed indefinitely.

Source: Data were provided by the companies listed.
(1) Copper in matte, blister and anode.

TABLE 7. COPPER REFINERIES IN CANADA, 2001

Company and Location	Rated Annual Capacity	Remarks
	(tonnes)	
CCR Refinery Noranda Inc. Montréal-Est, Quebec	360 000	Refines anodes from Noranda's Horne and Gaspé smelters, and also from purchased scrap and anode scrap. Precious metals, selenium and tellurium are recovered from slimes. Modernization program completed in July 1999 will raise capacity to 360 000 t/y by 2001.
Inco Limited Copper Cliff, Ontario	140 000	Casts and refines anodes from molten converter copper from the Copper Cliff smelter, and also refines purchased scrap. Gold, silver, selenium and tellurium cake are recovered from anode slimes. Recovers and electrowins copper from Copper Cliff nickel refinery residue. Annual capacity is a function of copper content in concentrates produced.
Inco Limited Copper Cliff, Ontario	9 000	Electrowinning plant processes copper-bearing fluids.
Falconbridge Limited Timmins, Ontario	147 000	Refines anodes from the Kidd Creek smelter. Incremental expansion increased capacity to 147 000 t/y in 2000.
Boliden Limited McLeese Lake, British Columbia	2 000	Dissolved copper-in-solution from heap leaching operations is treated in a solvent extraction plant and then electrowinned to produce copper cathode. Production suspended in December 1998. Operation sold to Taseko Mines Limited in April 1999.

Source: Data were provided by the companies listed.

TABLE 8. U.S. SUPPLY OF WIRE MILL, BRASS MILL, FOUNDRY AND POWDER PRODUCTS, AND THEIR USES, 1999 AND 2000

United States	1999	2000 (p)
	(000 t)	
SUPPLY		
Domestic mill products		
Building wire	645	650
Magnet wire	353	363
Telecommunications cable	295	306
Power cable	142	145
Automotive wire and cable	172	179
Electronic wire and cable	118	136
Other wire and cable	301	311
Strip, sheet, plate and foil	610	646
Rod and bar	562	566
Tube and pipe	583	567
Mechanical wire	43	45
Foundry products	174	175
Powder products	20	21
Total, domestic mill products	4 017	4 110
Imported mill products	142	222
Total supply	4 159	4 332
USES		
Building construction	1 690	1 696
Electrical/electronic products	1 093	1 196
Industrial machinery/equipment	449	458
Transportation equipment	492	497
Consumer and general products	435	485
Total	4 159	4 332

Source: Copper Development Association Inc.
(p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 9. YEARLY AVERAGE COPPER PRICES,(1) 1981-2001

Year	LME
	(current US¢/lb)
1981	79.0
1982	67.1
1983	72.1
1984	62.5
1985	64.3
1986	62.3
1987	80.9
1988	117.9
1989	128.9
1990	121.0
1991	106.2
1992	103.7
1993	86.8
1994	104.7
1995	132.9
1996	104.1
1997	103.2
1998	75.0
1999	71.3
2000	84.4
2001	71.8

Source: International Copper Study Group.
(1) Grade A, Cash.

TABLE 10. MONTHLY AVERAGE COPPER PRICES, 2000 AND 2001

	LME (1)		COMEX (2)	
	2000	2001	2000	2001
	(current US¢/lb)			
January	83.6	81.10	84.8	83.70
February	81.7	80.09	82.4	82.01
March	78.9	78.87	79.6	80.07
April	76.2	75.49	77.4	76.30
May	82.8	76.30	82.8	76.84
June	79.5	72.96	80.7	72.58
July	81.6	69.18	83.9	69.44
August	84.2	66.43	86.7	67.34
September	88.9	64.70	91.5	65.41
October	86.1	62.47	87.6	63.20
November	81.4	64.76	83.2	66.09
December	83.9	66.76	86.9	67.83

Source: International Copper Study Group.
(1) LME cash price for Grade A copper. (2) COMEX First Position High Grade price.

TABLE 11. WORLD COPPER SCRAP RECOVERY AS A PERCENTAGE TOTAL REFINED PRODUCTION, 1998-2000

	1998		1999		2000	
	(000 t)	(%)	(000 t)	(%)	(000 t)	(%)
Europe	2 088	14.8	2 186	15.1	2 134	14.4
Asia	1 415	10.0	1 327	9.2	1 270	8.6
Africa	37	0.3	33	0.2	37	0.3
America	1 826	12.9	1 673	11.6	1 638	11.0
Oceania	45	0.3	60	0.4	–	–
Total (1)	5 411	37.2	5 279	36.5	5 079	34.4

Source: World Bureau of Metal Statistics.
– Nil.
(1) Final percentage calculation includes refined copper from other countries.

Diamonds

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SUMMARY

Major events in the Canadian and international diamond industry during 2000 and 2001 included the following:

- The Diavik diamond project in the Northwest Territories received its regulatory permits, allowing construction to begin at the mine site. The $1.3 billion mine is expected to begin production early in 2003.
- BHP Diamonds Inc. (now BHP-Billiton) bought Dia Met Minerals Ltd. for $687 million to consolidate its interest in the Ekati™ diamond mine at 80%.
- De Beers Canada Mining Inc. bought Winspear Diamonds Inc. in 2000 for $305 million. This gave De Beers a 68% interest in the Snap Lake diamond project. In early 2001, De Beers purchased the remaining 32% interest in the project from Aber Diamond Corporation for $173 million. In August 2001, De Beers announced that it would delay production at Snap Lake by one year to 2006.
- In mid-2001, De Beers Consolidated Mines Limited completed its privatization process and was delisted from the Johannesburg Stock Exchange. The company is now the world's largest private diamond miner.
- In 2000, the diamond trading arm of De Beers, Diamond Trading Company (DTC), sold a record $5.67 billion worth of diamonds. The final sales figures for 2001 are expected to be down substantially as sales in the first half were down by 26% to $2.62 billion and second-half sales are usually lower than first-half sales.
- In Australia, the ownership of Ashton Mining and its 40% interest in the Argyle diamond mine were hotly contested by Rio Tinto and De Beers. In the end, Rio Tinto prevailed and purchased Ashton for A$713 million.
- During 2000-01, the Kimberley Process to address the conflict diamonds issue took shape and resulted in a proposed international certification scheme for rough diamonds that will be fully implemented by the end of 2002.

CANADIAN DEVELOPMENTS

Mine Developments

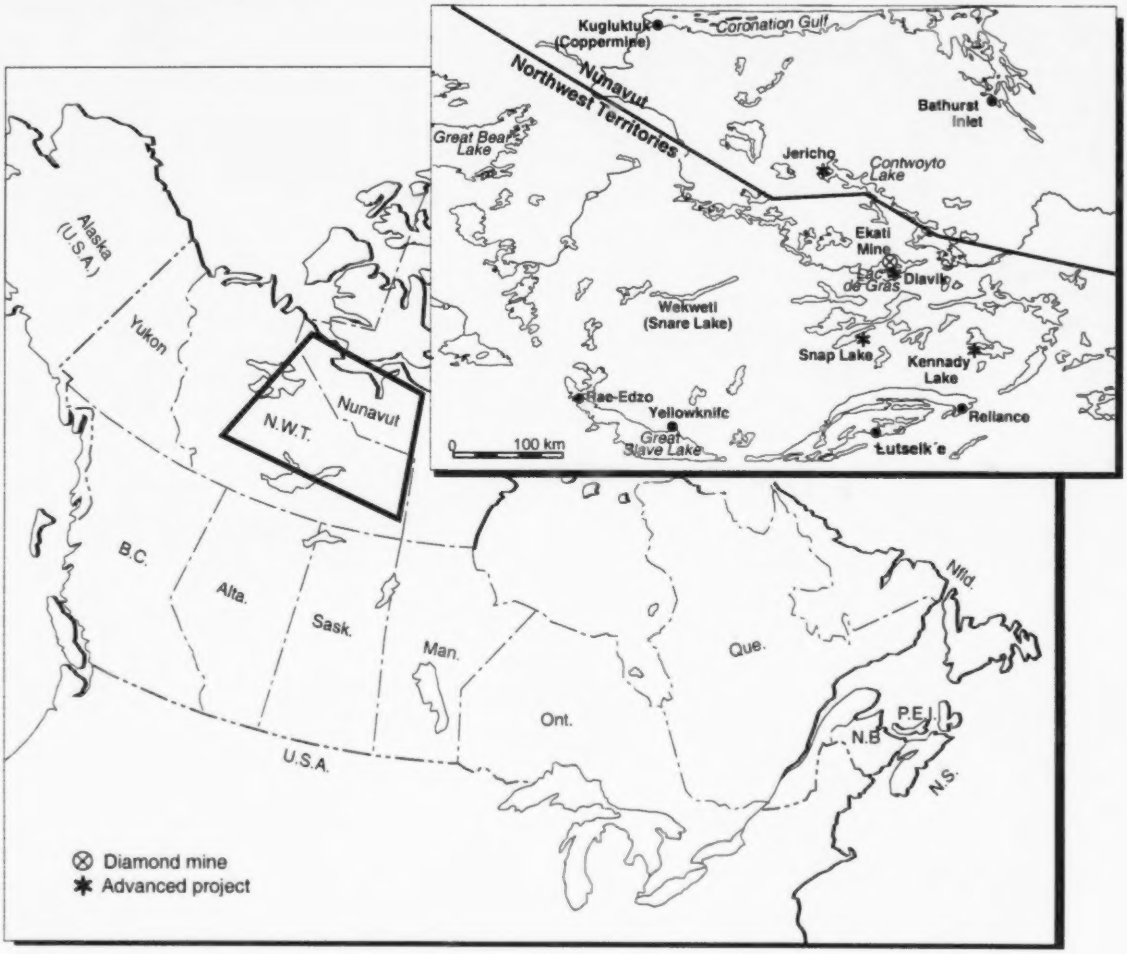
Ekati™ Mine

Ownership of the Ekati™ diamond mine was consolidated in mid-2001. BHP Limited of Australia completed a $687 million buy-out of Canadian-owned Dia Met Minerals Ltd. of Kelowna, British Columbia. Dia Met's major asset was its 29% interest in the Ekati™ mine. Ownership of the mine is now BHP with 80% and Charles Fipke and Stewart Blusson each with 10%. At the same time, BHP Limited and Billiton PLC of the United Kingdom were completing a merger to create BHP-Billiton and become the largest mining company in the world.

The Ekati™ diamond mine is located near Lac de Gras, about 300 km northeast of Yellowknife in the Northwest Territories. At full capacity, annual production is expected to be about 3.5-4.5 million ct. At this level, the mine will account for about 4% of global diamond production by weight and 6% by value.

In December 2001, production from the Misery pipe began. This pipe has an estimated ore reserve of about 5.4 Mt grading 3.3 ct/t with an average value of US$34/ct. Ore from the Misery pipe is trucked 30 km over an all-weather road to the recovery facility.

Figure 1
Diamond Properties, Slave Province


Kugluktuk (Coppermine)
Coronation Gulf
Nunavut
Northwest Territories
Bathurst Inlet
Great Bear Lake
Jericho
Contwoyto Lake
Ekati Mine
Lac de Gras
Diavik
Wekweti (Snare Lake)
Snap Lake
Kennady Lake
Rae-Edzo
Yellowknife
Great Slave Lake
Reliance
Lutselk'e
0
100 km
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
⊗ Diamond mine
✱ Advanced project

Source: Indian and Northern Affairs Canada.

After an intensive three-year environmental assessment by the Mackenzie Valley Environmental Impact Review Board on its proposal to mine the Sable, Beartooth and Pigeon pipes, BHP-Billiton received approval to start the regulatory approval phase. This next phase involves the government issuing the permits and licences that contain the terms and conditions which the company must meet during development and production. The addition of these pipes to the mining plan will extend the life of the mine by 3 years to an estimated 18 years.

Ongoing exploration on the company's claim block has identified some 126 diamondiferous kimberlite pipes.

BHP-Billiton continues to meet its commitments to purchase goods and services from northern companies and to hire northern Aboriginals and Northerners on a priority basis. BHP employs about 550 people. Some 80% of the Ekati™ mine's staff are Northerners, of which over 50% are Aboriginals.

Diavik Diamond Project

The Diavik diamond project is an unincorporated joint venture between Diavik Diamond Mines Inc. (DDMI) (60%) and Aber Diamond Mines Ltd. (40%). DDMI is headquartered in Yellowknife, Northwest Territories, and is a wholly owned subsidiary of Rio Tinto plc of London, England. Aber Diamond Mines Ltd. is a wholly owned subsidiary of Aber Diamond Corporation (formerly Aber Resources Ltd.) of Toronto, Ontario. The two joint-venture participants retain the right to market independently their respective share of the diamonds to be produced from the Diavik diamond mine. DDMI is the manager of the project.

The Diavik diamond project underwent an intensive environmental assessment and regulatory approval process that began in March 1998 and culminated in December 2000 when, after receiving all of the necessary permits and licences, Diavik and Aber announced that they would begin construction of the $1.3 billion project.

As part of the approval process, in addition to its land use permits, land leases, a Class A water licence, explosive permit, and fish habitat and navigable water authorizations, the company signed a number of agreements with the federal and territorial governments as well as participation agreements with five affected Aboriginal groups.

The Diavik diamond project is a proposal to mine four kimberlite pipes located just offshore of a 20-km^2 island in Lac de Gras, approximately 300 km northeast of Yellowknife and 30 km southeast of BHP-Billiton's Ekati™ diamond mine. The pipes are referred to as A-154 South, A-154 North, A-418 and A-21.

The diluted proven and probable reserves included in the mine plan are estimated at 25.6 Mt of ore grading 4.0 ct/t. It is expected that the Diavik mine will produce 101.5 million ct of diamonds at an average value of US$63/ct (2000 valuation) over its mine life.

The Diavik project plan calls for a two-year ramp-up period after which annual kimberlite processing is expected to reach 1.5 Mt and diamond production is forecast to average approximately 6 million ct.

Mining of all pipes will be by open-pit methods and will finish with underground mining of selected pipes. DDMI plans to build three water-retention dikes from shore to surround the four diamond-bearing pipes to enable mining to occur.

Construction of the first water-retention dike around the two A-154 pipes began in 2001 to enable dewatering and overburden removal in the second half of 2002. Construction of a physical plant (including the maintenance shop, accommodation complex, power generation facility, and processing plant) also began in 2001 with completion planned for 2002. Diamond production is scheduled to commence in the first half of 2003.

By September 2001, construction costs had reached $655 million. It is expected that in 2002 an additional $385 million in goods and services will be spent. The project remains within its targeted budget of $1.3 billion.

In late 2001, Aber announced that it will receive a US$230 million debt facility from a consortium of banks including the Bank of Montreal, the Canadian Imperial Bank of Commerce, the Deutsche Bank, the Royal Bank, and the Export Development Corporation. The loan is one of the largest debt financings ever provided for a mine in Canada.

Snap Lake Project

The Snap Lake diamond deposit is located approximately 220 km northeast of Yellowknife in Canada's Northwest Territories. The deposit is unique in that the diamondiferous kimberlite is in the form of a dyke as opposed to a normal pipe. The dyke is a tabular-shaped structure about 2.5 m thick that dips at a shallow angle of 15°.

The indicated resource is presently estimated to be 22.8 Mt and has been delineated over an area of approximately 2.5 by 2.5 km.

Originally the project was a joint venture between two Canadian companies, Winspear Resources Inc. (later Winspear Diamonds Inc.) (67.76%) and Aber Resources (32.24%). However, in August 2000, De Beers Canada purchased Winspear for $305 million, thereby gaining ownership of Winspear's interest in

Snap Lake. Then, in February 2001, De Beers purchased the remaining interest in the property from Aber Diamond Corporation for $173 million.

Once it owned 100% of the Snap Lake project, De Beers filed Land and Water Use Permit Applications to allow construction of a 3000-t/d underground diamond mine. In May, the project was referred for environmental assessment and this process is currently under way.

In August 2001, De Beers announced a one-year delay in the development of the Snap Lake project. Production is now expected to commence sometime in 2006.

Jericho Project

Tahera Corporation completed a feasibility study on the Jericho diamond project in June 2000. The feasibility study considered the economics of constructing a modest-sized mining operation centred on the land-based Jericho kimberlite pipe. The feasibility study indicates that 3 million ct will be produced over an eight-year mine life. The project is located in Nunavut about 170 km north of Lac de Gras.

Tahera has filed a formal project proposal for the Jericho diamond project with the relevant authorities and submitted a draft Environmental Impact Statement (EIS) in early 2001. These filings marked the formal commencement of the environmental assessment and regulatory approval process for the proposed Jericho diamond mine.

In September 2001, Tahera signed a letter of understanding with Kennecott Canada Exploration Inc. (owned by Rio Tinto PLC). Under the terms of the letter, by fufilling a number of obligations, including spending $1 million and drilling a minimum of 20 kimberlite targets, Kennecott will have the option to incorporate the Jericho project in the existing joint-venture agreement it has with Tahera on the Rockinghorse and Hood River properties, which are about 120 km northeast of the Jericho project in Nunavut.

Exploration Developments

Diamonds remain a prime exploration target in the North as well as in most of the southern provinces. Some projects at the advanced exploration stage are outlined below.

In Saskatchewan, the Fort à la Corne diamond project received promising results following a large-diameter drilling program carried out during 2001. The project, located 50 km northeast of Prince Albert, is a joint venture among De Beers Canada Exploration Inc. (wholly owned by De Beers) (42.25%), Kensington Resources Ltd. (42.25%), Cameco Corporation (5.5%) and UEM Inc. (10%). De Beers is the operator of the project. Independent valuations of the diamonds recovered indicate diamond values of about US$150/ct. Work is expected to continue to determine the total resource.

In Ontario at the Victor project in the James Bay lowlands, about 90 km west of Attawapiskat on the coast, De Beers Canada continued a bulk sampling program. During 2000-01, a bulk sample of approximately 10 000 t was extracted from the Victor pipe. The sample was processed on site and the data recovered showed considerable variation in the concentration of diamonds. De Beers is continuing its evaluation of the project and may proceed with a prefeasibility study.

In Quebec, the Ashton Mining Corporation of Canada and SOQUEM Inc. joint venture reported the discovery of two diamondiferous kimberlite pipes in north-central Quebec. The two pipes, Renard 1 and 2, were drilled and returned both macro- and micro-diamonds. The partners are planning a significant exploration program in the region for 2002.

On the eastern shore of the Ungava Bay in northern Quebec, Twin Mining Corporation is focusing on the 4.5-km-long Torngat North area. The ongoing exploration program for Torngat is expected to identify other sections of the dyke system of higher diamond grade. If test samples warrant, a 2000 to 5000-t bulk sample will be taken. Diamond drilling to establish the down-dip attitude of the dyke is planned as well.

In Nunavut, in the area south of Coronation Bay, Ashton Mining and Kennecott Canada reported encouraging results from kimberlites discovered in the northern part of the Slave craton. Also in Nunavut, Twin Mining reported the recovery of macro-diamonds from the Freightrain pipe at Jackson Inlet on Baffin Island.

The Northwest Territories remains a focal point for diamond exploration. Evaluation work by De Beers Canada continues on the Kennady Lake property where results of a large-diameter drilling program are expected to determine whether additional work is warranted.

Canadian Government Diamond Valuator

In the Northwest Territories and Nunavut, the Canada Mining Regulations require that all diamonds produced in the territories be examined by a government valuator in order to establish a value for the diamonds for the purpose of calculating royalties owed to the Crown. The valuation must be done before the diamonds are sold or exported out of the territories.

In August 1998, the Canadian government, represented by the Department of Indian Affairs and Northern Development, signed a three-year contract with Diamonds International Canada (DICAN) Ltd. DICAN is a Canadian incorporated company with headquarters in Yellowknife, Northwest Territories. It is a partnership between Aboriginal Diamonds Group Ltd. (51%) and WWW International Diamond Consultants Ltd. (49%). In mid-2001, the contract was extended for an additional two years.

DICAN has a team of nine individuals with expertise in the valuation of rough diamonds and in statistical analysis of rough diamond production. As required by regulation, DICAN provides the government with a value of diamond production from the Ekati™ mine for use in the calculation of royalties that BHP-Billiton will pay to the Crown.

In addition to providing its valuation services, DICAN is also committed to providing valuation training to Canadians. Initially, northern Aboriginals will be given priority for the training program after which other Northerners and other Canadians will be targeted. To date, two candidates have taken the training and one currently participates in the valuation process.

CANADIAN DIAMOND MANUFACTURING

Diamond Cutting and Polishing

In comparison to other countries with cutting and polishing industries, the Canadian industry is fairly new and still quite small. However, the start of Canada's mine production of rough diamonds has created quite an interest in establishing new facilities in this country.

There are now three cutting and polishing factories operating in Yellowknife. BHP-Billiton Plc has contracts to supply each facility with up to 2500 ct in each five-week period. The factories require specific assortments of diamonds, which BHP-Billiton prepares at its sales offices in Antwerp, Belgium. The assortments are then shipped back to the company's sorting and valuation facility in Yellowknife and sales to the factories take place there. BHP-Billiton expects to have trained Northerners to a level that will allow the assortments for the northern factories to be prepared in Yellowknife prior to shipping the remainder of the production to Antwerp.

The first facility in Yellowknife was established by Sirius Diamonds Ltd. in June 1999. The company employs about 30 people, most of whom are Northerners. Sirius diamonds are marketed as Polar Bear diamonds.

The second factory, which was constructed by Deton'cho Diamonds, majority owned by the Yellowknives Dene, began production in March 2000. The factory is located in Ndilo, a Yellowknives Dene community adjoining Yellowknife. It has about 20 employees, most of whom are Aboriginal trainees. The company markets its diamonds under the Loon Diamond trade name.

Arslanian Cutting (NWT) Works (in association with the Dogrib Rae Band) began production in December 2000. Arslanian Cutting (NWT) Works and the Dogrib Rae Band have signed a mentoring agreement whereby Arslanian Cutting Works will provide training and other assistance to the Dogrib Rae Band in establishing a future factory in the Northwest Territories, most likely in the Dogrib community of Rae Edzo, 120 km west of Yellowknife.

In order to maximize initial production, Arslanian Cutting Works brought 30 experienced polishers from its factories in Armenia. The company also established a one-on-one training program to train Northerners in the art of cutting and polishing rough diamonds. This operation is unique in that the parent organization is also a core customer of BHP-Billiton Diamonds in Antwerp, Belgium.

Together, the three facilities can purchase approximately 10% (by value) of BHP's production. They will create approximately 80 diamond cutting jobs with an additional 20-25 support positions.

The Government of the Northwest Territories (GNWT) has signed a Memorandum of Understanding with Diavik Diamond Mines Inc. concerning access to rough diamonds for N.W.T. manufacturers. Discussions are also under way with Aber Diamond Corporation. It is anticipated that these and future projects will provide further opportunities for Northerners.

Other manufacturers include Cohenor Inc. and Hope Diamond Co. with small factories in Montréal, Quebec, and Polar Star with a factory in Edmonton, Alberta.

The General and Vocational College of Matane, Quebec (Collège d'enseignement général et professionnel [CÉGEP] de Matane) offers a course on diamond cutting and polishing. A new Matane firm, Papillon Gemme Inc., has cut Quebec's first diamond. The diamond was recovered by Twin Mining Corporation from the Torngat property in northern Quebec. The gem, on display at the Museum of Civilization in Québec City, is the first diamond to be recovered and cut and polished in Quebec. The presence of the training program for diamond cutters was a major factor in the company's decision to locate in Matane. The firm intends to sign an agreement with Twin Mining Corporation to purchase diamonds and cut them in Matane.

In mid-2001, the GNWT introduced a diamond certification scheme for diamonds that have been mined and cut and polished in the Northwest Territories. Under the certification process, the GNWT observes when packages of rough diamonds purchased from BHP-Billiton are opened and marked for manufacture; as well, the GNWT inspects the factories to examine the diamonds during production and reviews the factory's records. All certified diamonds must meet the minimum standard of cut that has been established by the N.W.T. diamond industry. Each diamond also undergoes the Gemprint process, which provides a unique image of each diamond for identification in case of loss or theft.

Currently, Deton'cho Diamonds Inc. and Arslanian Cutting Works (NWT) participate in the GNWT certification program. Sirius Diamonds Ltd. has chosen not to participate in it.

In November 2001, the GNWT introduced a discussion paper on proposed legislation to license diamond manufacturers in the N.W.T. The results of the discussion will be known sometime in 2002.

In early 2001, BHP Diamonds Inc. (now BHP-Billiton) launched its own Ekati™ brand of diamonds. Each Ekati™ diamond is accompanied by three certificates. One is from the American Gem Society Laboratories (AGS), which provides unbiased third-party verification of the diamond's specifications (colour, clarity, cut and carat weight). The second is the GNWT certificate outlined above, which validates the diamond's Canadian origin. The third certificate guarantees that the diamond is from the Ekati™ mine. In order to receive a certificate, the finished diamond must weigh at least one third of a carat and meet the AGS Triple Ideal grade of cut.

Diamond Tools and Equipment Manufacturing

These products include drill bits, segments for circular blades, grinding wheels and specialty tools. The major manufacturing plants are: Fordia at Ville St-Laurent, Quebec; Diamond Production at Montréal, Quebec; North Star Abrasives at Montréal, Quebec; Diacan at Québec City, Quebec; Diamond Systems at Dorval, Quebec; Dimatec at Winnipeg, Manitoba; JKS Boyle, Longyear, JKS Lamage, and Pilot Diamond Tools, all in North Bay, Ontario; Diaset Products at Delta, British Columbia; and Hobic Bit Industry at Richmond, British Columbia.

Diamond Jewellery Manufacturing

There are approximately 20 major jewellery manufacturing plants located mainly in the Toronto region with a few in Montréal. There are also several smaller plants in Montréal.

Synthetic Diamond Production

Crystalline Manufacturing Ltd. of Calgary, Alberta, produces synthetic diamond films using the Carbon Vapour Deposition (CVD) method.

WORLD EVENTS

Conflict Diamonds

The term "conflict diamonds" refers to those rough diamonds that are used by rebel movements or their allies to finance conflict aimed at undermining legitimate governments, as described in relevant United Nations Security Council (UNSC) resolutions insofar as they remain in effect, or in other UNSC resolutions that may be adopted in the future, and as understood and recognized in the United Nations General Assembly (UNGA) resolution 55/56 or in other similar UNGA resolutions that may be adopted in the future.

Currently, under UNSC sanctions, only those exports of diamonds from Sierra Leone and Angola that have an official certificate of origin issued by the government can be imported by a UN member country. As well, under UNSC sanctions, no exports of rough diamonds from Liberia may be imported by a UN member country.

The Kimberley Process on Conflict Diamonds

The Kimberley Process derives its name from the city in South Africa that is synonymous with diamonds and was the location of the first meeting of countries whose ultimate goal was to develop a scheme to prevent conflict diamonds from entering the legitimate diamond trade.

That first meeting was held in May 2000 and was followed by several technical experts meetings in Luanda, Angola; London, England; and Windhoek, Namibia. In September 2000, a ministerial-level meeting was held in Pretoria, South Africa, at which it was agreed to co-sponsor a resolution on conflict diamonds, which was passed at the 55th session of the UNGA in December 2000.

The resolution called for breaking the link between the illicit transaction of rough diamonds and armed conflict as a contribution to the prevention and settlement of conflicts. In addition to the resolution, the UNGA encouraged the member countries of the Kimberley Process to continue their work and to consider expanding the membership of the Process to allow all key states with significant interest in the world diamond industry to participate in further meetings and to move ahead with the process to develop detailed proposals for an envisaged international certification scheme for rough diamonds in close collaboration with the diamond industry and civil society.

During 2001, there were six plenary meetings of the Kimberley Process, each building on the work of the previous meetings. The meetings were attended by representatives of 35 governments of producing, exporting and importing countries, industry through the World Diamond Council, and civil society, including Partnership Africa Canada, Global Witness, Amnesty International, and Fatal Transactions.

The first meeting in February in Windhoek, Namibia, set out a road map for the continued progress on negotiating an international certification scheme that would break the link between rough diamonds and armed conflict. Subsequent plenary sessions were held in April in Brussels, in July in Moscow, in September in London, and in October in Luanda, Angola.

Immediately following the sixth plenary meeting in November in Gaborone, Botswana, Ministers representing the world's leading diamond-producing, exporting and importing states declared that the detailed proposals for an international certification scheme developed by participants in the Kimberley Process provided a good basis for the envisaged certification scheme.

The Ministers encouraged those states already in a position to issue a certificate to do so immediately and all others to start issuing certificates by mid-2002 with the intent of having full simultaneous implementation by the end of 2002.

In the United States, the *Clean Diamond Trade Act* was passed by the House of Representatives in November 2001. The next step will be passage of the Bill by the U.S. Senate, which is expected sometime in the fall of 2002.

In Canada, Mr. David Pratt, a federal Member of Parliament, introduced a private members bill that would prohibit the importation of conflict diamonds into Canada. The Bill, introduced in October 2001, if enacted, would prohibit the import of diamonds and jewellery containing diamonds from countries that do not have a system for controlling the import and export of rough diamonds.

World Natural Rough Diamond Production

World production of natural rough diamonds in 2000 was estimated by Terraconsult bvba of Belgium at 110.7 million ct valued at US$7.8 billion, for an average price of US$71/ct.

In 2000, the major producing countries included: Botswana with 24.6 million ct valued at US$2.1 billion, Russia with 20.5 million ct valued at US$1.6 billion, South Africa with 10.5 million ct valued at US$1.1 billion, the Democratic Rebublic of Congo with 16.5 million ct valued at US$585 million, Angola with 4.0 million ct valued at US$740 million, Namibia with 1.5 million ct valued at US$419 million, Australia with 26.2 million ct valued at US$360 million, and Canada with 2.6 million ct valued at US$454 million.

In South Africa in June 2001, De Beers, the world's largest diamond miner, completed a US$18 billion privatization program that resulted in the de-listing of its shares from the Johannesburg Stock Exchange. The new private De Beers is held by DB Investments SA, which is a consortium of Anglo American (45%), the Oppenheimer family-owned Central Holdings Ltd. (45%), and Debswana Mining Company, a joint-venture partnership between the Government of Botswana and De Beers (10%).

At the end of 2001, De Beers and the Russian diamond mining company Alrosa finalized a new five-year marketing agreement worth US$4 billion. Under the terms of the agreement, De Beers is guaranteed US$500 million of Alrosa's run-of-mine diamond production in 2002 as well as US$300 million of an export assortment. The run-of-mine component for the remaining four years will be negotiated during 2002. The remaining 50% of Alrosa's annual production will be available to Russian manufacturers or Alrosa may decide to sign distribution contracts with other diamond distributors.

In Namibia, the Namibian Minerals Corporation announced that its major shareholder, LL Mining Corporation BV, had provided a US$10 million loan facility that will maintain the company's liquidity while its diamond recovery from its new seabed miner, which replaced one lost in an accident early in 2001, is being commissioned. Namdeb Diamond Corporation (the Namibian government [50%] and De Beers [50%] joint venture) reached its targeted production of 1.3 million ct in 2000 and is expected to maintain that production level over the next decade.

In Angola, production at the Catoca kimberlite deposit reached 1.9 million ct from 2.6 Mt of ore in 2000, and was expected to be higher in 2001 as ore production was expected to reach about 3.0 Mt. The joint-venture partners, Alrosa of Russia (32.8%), the Angolan state-owned Endiama (32.8%), Daumonty Finance (18%), and Odebrecht of Brazil (16.4%), are considering a feasibility study to increase ore production at Catoca to 6-7 Mt/y.

In Australia, Rio Tinto, following an intensive bidding war, consolidated its ownership of the Argyle diamond mine in Western Australia by purchasing

Ashton Mining Pty, which owned a 40% interest in the mine, for US$432 million. In 2000, the mine produced some 26.5 million ct. Production for 2001 is expected to be down somewhat as production for the first nine months was down 2.9 million ct to 18.1 million ct when compared to the same period in 2000. The company is making an A$280 million capital investment that will result in underground production commencing in 2006 and extending the mine life to 2018.

For the first time since it split from De Beers, production from the Argyle mine was stockpiled and not sold as diamond markets weakened in October and November 2001. The company resumed sales in December.

In Russia, Alrosa Co. Ltd. (formerly Almazy Rossii-Sakha) has begun a major capital spending program that will see some of its older open-pit operations begin production from underground developments. As well, Alrosa intends to increase annual production from its operations in Yakutia. The company expects to spend about 97.8 billion roubles by the end of 2005, at which time production should reach US$1.9 billion annually.

Factors Affecting Diamond Mining

Grade

Grade is the weight of diamonds expressed as carats per tonne (ct/t) of ore. It varies widely from one mine to another, but generally falls somewhere between 0.3 and 1.3 ct/t. The value of the ore per tonne equals the grade times the average value per carat of all the individual diamonds in the deposit.

Size (Weight) of Rough Diamonds in the Deposit

Individually, rough diamonds can range in size from micro-sized to stones weighing in excess of 1000 ct. A much more telling measure of a mine's production is the average size of its rough diamonds. Depending on the mine, the average size of rough diamonds recovered can vary from 0.01 ct (about 1 mm in size) to more than 0.7 ct.

Many mines in the world average about 0.4-0.5 ct per stone. It is interesting to note that the number of stones larger than 1 ct (0.2 g) produced at mines is very small (about 400 000 stones per year) and, in terms of total carats produced, this represents only about 0.5% of world production.

Mine Production Costs

According to different sources, production costs (excluding depreciation and interest) for kimberlites and lamproites are approximately US$5-$6/t for large and easy-to-access diamond mines operating in good climatic conditions, and are up to about US$35-$38/t for small mines located in remote areas and operating under harsh climatic conditions. The total production costs for these mines are around US$15/t and US$40-$45/t, respectively.

PRICES

There are no international prices for diamonds such as there are for precious metals like gold, silver and platinum and for base metals such as copper, lead and zinc. The market prices for rough natural diamonds are almost constantly in a state of flux.

NATURAL DIAMONDS

Natural industrial diamonds: Crushing bort sells for about US30¢/ct; casting sells for US$1-$2/ct; industrial stones sell for US$7-$10/ct; flets (e.g., a high-quality thin macle) sell for US$50/ct; and dies (larger diamonds of high quality but with poor [often yellow] colour that makes them unsuitable as gems) sell for up to US$200/ct.

Gem-quality rough diamonds: The price of a rough stone depends on its carat weight, shape, clarity and colour. The prices vary widely, but the following is an indication of the prices paid at cutting and polishing factories for gem-quality rough stones: a 1-ct stone that sells for US$20 is very low quality, US$200 is medium quality, US$400 is good quality, and US$1000 is top quality.

Synthetic Diamonds

Synthetic diamond prices depend on their particle strength, size and shape, and whether or not the diamonds are coated with a metal, etc. For this reason, there are several hundred prices for synthetic industrial diamonds. Generally speaking, synthetic diamonds used in grinding and polishing vary in price from US30¢/ct to US$1/ct. Strong and blocky material for use in sawing and drilling, and known in the trade as SDA and MBS (produced respectively by De Beers and General Electric), sells for up to US$3/ct. Large single crystals with excellent structure for use in specific applications sell for several hundred dollars per carat.

OUTLOOK

The diamond industry is in a period of change, the effects of which will continue for the short to medium term.

There has been a significant consolidation in production and, at the same time, larger amounts of rough diamonds are being sold outside of the Diamond

Trading Company as seen by: the new De Beers/Russia sales agreement; the combined Rio Tinto production from both Argyle and DDMI production expected to come on stream in 2003; 65% of the existing Canadian production (until December 2002 when the contract with De Beers ends); and the emergence of Israeli business man Lev Leviev as the sole marketer of Angolan production.

In the polished diamond industry, there has been a movement towards branding and associating the product with purity or high quality of colour, clarity and cut, or with other known brand names as seen with the Canadian Arctic North certificate of the Government of Northwest Territories, the EKATI™ brand, which guarantees the source as Canada and the quality of cut to be triple excellent, and the joint marketing agreement between De Beers and LVMH, the European marketer associated with luxury goods.

The pending final outcome of the Kimberley Process and its international certification scheme, combined with the proposed legislation for rough and polished diamond imports into both the United States and Canada, will have an impact on the way business is done by the international diamond industry. The World Diamond Council, which represents industry, has proposed an industry-guaranteed chain of warranties that would be part of the Kimberley Process certificates.

At the same time, the world economy is in a period of slowdown and it remains to be seen when there will be an actual recovery.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of December 2001. (3) More detailed information on diamonds is available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html and at www.gov.nt.ca/RWED/diamond/index.htm.

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TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set	Free	Free	Free	Free
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted, but not mounted or set	Free	Free	Free	Free
7102.29	Diamonds, industrial, other	Free	Free	Free	Free
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted	Free	Free	Free	Free
7102.39	Diamonds, non-industrial, other	Free	Free	Free	Free
7105.10	Natural or synthetic diamond dust or powder	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, DIAMOND PRODUCTION AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
PRODUCTION							
	Northwest Territories	2 428 783	606 254	2 435 036	624 949	3 685 171	846 925
	Total	2 428 783	606 254	2 435 036	624 949	3 685 171	846 925
EXPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Belgium	2 317 851	523 987	1 810 401	470 752	2 202 320	507 524
	United Kingdom	81 156	21 178	706 349	182 747	763 074	187 622
	United States	1 767	553	800	1 504	2 009	2 997
	Other countries	42	13	1 912	437	3	21
	Total	2 400 316	545 731	2 519 462	655 440	2 967 406	698 164
7102.21	Diamonds, industrial, unworked or simply sawn, cleaved or bruted						
	United States	6 800	178	906	65	2 472	60
	Total	6 800	178	906	65	2 472	60
7102.29	Diamonds, industrial, other						
	United States	185	141	25	134	1 152	174
	United Kingdom	–	–	–	–	182	2
	Total	185	141	25	134	1 334	176
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted						
	United States	26 729	4 017	10 651	1 520	81	57
	New Zealand	–	–	–	–	21	12
	Israel	–	–	41	106	–	–
	Australia	–	–	8	4	–	–
	Total	26 729	4 017	10 700	1 630	102	69
7102.39	Diamonds, non-industrial, other						
	United States	3 036	9 468	4 806	13 367	7 180	23 298
	Belgium	248	132	1 076	838	114	728
	Hong Kong	–	–	–	–	36	204
	Other countries	–	–	1 359	781	18 568	13
	Total	3 284	9 600	7 241	14 986	25 898	24 243
7105.10	Natural or synthetic diamond dust and powder						
	United States	117 795	66	92 543	80	52 726	50
	Hong Kong	–	–	476	1	–	–
	Total	117 795	66	93 019	81	52 726	50
IMPORTS							
7102.10	Diamonds, unsorted, whether or not worked, but not mounted or set						
	Israel	. .	15 032	. .	31 690	. .	34 658
	India	. .	14 600	. .	15 495	. .	13 193
	United States	. .	10 665	. .	11 927	. .	10 152
	Belgium	. .	8 352	. .	9 221	. .	7 464
	Canada	. .	572	. .	1 282	. .	1 549
	United Kingdom	. .	2 334	. .	905	. .	1 419
	Other countries	. .	1 464	. .	1 341	. .	754
	Total	. .	53 019	. .	71 861	. .	69 189

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
IMPORTS (cont'd)							
7102.21.00.10	Diamonds, industrial, bort and black, diamonds for borers, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	Belgium	62 990	525	74 336	473	85 754	482
	United Kingdom	73 755	407	74 656	305	76 896	390
	United States	83 552	393	168 290	663	49 392	245
	Ghana	46 983	229	78 472	285	63 789	237
	South Africa	3 652	28	8 488	60	10 722	68
	Other countries	40 677	202	19 805	109	9 964	50
	Total	311 609	1 784	424 047	1 895	296 517	1 472
7102.21.00.90	Diamonds, industrial, other, unworked or simply sawn, cleaved or bruted, but not mounted or set						
	United States	47 495	244	73 538	603	78 147	460
	Ghana	8 657	53	7 941	46	25 919	205
	Belgium	13 761	81	13 335	99	8 534	71
	United Kingdom	7 266	33	3 354	25	10 194	69
	Japan	6 199	41	4 785	31	11 387	60
	Other countries	78 335	907	8 045	66	16 370	98
	Total	161 713	1 359	110 998	870	150 551	963
7102.29.00.10	Diamonds, industrial, other, bort and black diamonds, for borers, but not mounted or set						
	United States	560	97	1 226	139	2 604	130
	Australia	203	26	110	23	281	58
	Ireland	–	–	–	–	2 000	12
	Other countries	500	130	3 015	35	38	8
	Total	1 263	253	4 351	197	4 923	208
7102.29.00.90	Diamonds, industrial, other, other than bort and black, for borers, worked but not mounted or set						
	United States	16 664	156	854	172	4 153	305
	Ireland	187 991	1 108	145 022	1 071	38 382	201
	Belgium	5 964	440	12 091	329	5 321	114
	Other countries	1 462	126	1 943	92	933	133
	Total	212 081	1 830	159 910	1 664	48 789	753
7102.31	Diamonds, non-industrial, unworked or simply sawn, cleaved or bruted, not mounted or set						
	Belgium	3 359	2 380	4 619	3 285	3 664	3 029
	Israel	2 221	2 017	2 564	1 897	2 641	1 964
	India	78	48	233	22	1 384	439
	Other countries	737	278	1 837	407	2 408	859
	Total	6 395	4 723	9 253	5 611	10 097	6 291
7102.39.00.10	Diamonds, non-industrial, other, of a weight not exceeding 0.5 carats each						
	Israel	40 778	37 451	39 732	35 753	36 614	29 372
	Belgium	11 691	13 787	15 535	14 283	16 078	14 516
	United States	13 584	(r) 9 223	15 920	10 732	14 727	9 797
	India	6 181	2 821	7 460	3 368	9 618	3 989
	Other countries	1 514	1 069	1 185	1 445	1 669	1 604
	Total	73 748	(r) 64 351	79 832	65 581	78 706	59 278

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(carats)	($000)	(carats)	($000)	(carats)	($000)
7102.39.00.20	Diamonds, non-industrial, other, of a weight exceeding 0.5 carats each						
	Belgium	72 753	60 602	80 560	62 022	52 224	46 937
	Israel	44 756	41 749	48 117	46 769	43 565	37 820
	India	86 253	29 634	75 912	30 456	73 343	29 267
	United States	22 828	24 596	44 930	34 192	36 820	24 153
	Other countries	7 201	6 224	11 027	12 899	8 911	12 639
	Total	233 791	162 805	260 546	186 338	214 863	150 816
7105.10.00.10	Diamond dust for borers; dust mixed with a carrier in cartridges or in tubes						
	United States	348 188	885	421 508	1 037	344 258	857
	Belgium	–	–	–	–	22 754	39
	Ireland	27 601	114	59 719	126	5 224	16
	Ghana	11 056	38	10 842	38	3 900	10
	Other countries	18 284	56	11 711	37	7 942	19
	Total	405 129	1 093	503 780	1 238	384 078	941
7105.10.00.91	Natural diamond dust and powder						
	Ireland	59 411	134	7 052	26	193 213	429
	United States	102 805	324	150 451	447	147 288	416
	Belgium	1 917	7	20 552	72	11 031	39
	Ghana	20 795	42	1 000	1	6 663	17
	Other countries	22 154	67	3 487	13	561	1
	Total	207 082	574	182 542	559	358 756	902
7105.10.00.92	Synthetic diamond dust or powder						
	Ireland	817 749	2 438	1 530 223	3 868	2 329 026	4 579
	United States	990 403	1 397	1 224 678	2 414	1 439 075	3 097
	Belgium	9 219	24	189 673	306	117 575	174
	United Kingdom	1 045	4	1 530	6	61 564	92
	China	49 008	33	87 314	109	84 013	60
	Other countries	53 565	133	39 795	68	24 595	55
	Total	1 920 989	4 029	3 073 213	6 771	4 055 848	8 057

Sources: Statistics Canada; Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

Gold

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2001 mine production: $2.11 billion
World rank: Seventh
Exports: $2.22 billion (includes exports from recycled products and public and private reserves)

Canada	2001	2002	2003 (f)
	(000 tonnes)		
Production	160	153	154

(f) Forecast.

Gold is valued for its rarity, lustrous colour, malleability, ductility, high resistance to corrosion and conductivity. It has been treasured for its decorative and monetary value for at least 8000 years. Gold has a high density, its weight being equal to 19.3 times an equivalent volume of water. The main industrial uses for gold are in jewellery (78%) and electronics (5%). Gold bullion and coins, such as the Maple Leaf coin, are also important products.

ANNUAL AVERAGE SETTLEMENT PRICES, LONDON BULLION MARKET ASSOCIATION

1999	2000	2001	2002 (e)
(US$/troy oz)			
279	279	271	308

(e) Estimated.

CANADIAN OVERVIEW

- For the second consecutive year, Goldcorp Inc. will produce more than 15 t of gold (500 000 oz) at the Red Lake mine at a direct production cost of close to US$65/oz; this will place the mine, for the second year running, among the leading Canadian gold producers for volume of gold produced and among the producers with the lowest production costs in the world.

- In May, Kirkland Lake Gold Inc. (formerly Foxpoint Resources Ltd.) resumed processing operations at the Macassa mill using tailings and ore from surface inventories on the old Teck-Hugues and Lakeshore mining properties. The company is currently installing the equipment and services needed to restart mining activities in the upper levels of the Macassa mine, where it expects to initially produce about 7000 oz of gold per month early in 2003.

- In January 2002, McWatters Mining Inc. (then under the protection of the *Companies' Creditors Arrangement Act)* had its restructuring plan accepted by its creditors and shareholders. Under this plan, the company transferred all of the Sigma-Lamaque property to a limited partnership in which it holds a 60% interest with SOQUEM INC. holding the other 40% interest. The Sigma-Lamaque mine will go into production in early 2003 and will have a production capacity of nearly 150 000 oz/y over six years.

- In October, Agnico-Eagle Mines Limited completed work to expand its mill facilities at the LaRonde mine to 7000 t/d. With this expansion, annual gold production will increase to nearly 400 000 oz, a production level that could be reached in 2004. The ore at LaRonde also contains commercial ore-grade zinc, copper and silver, which will place this mine among those with the lowest production costs in Canada when the credits obtained for these metals are taken into account.

- In the first quarter of 2002, mining activities resumed at the Beaufor mine operated by Richmont Mines Inc. The mine had been closed in

August 2000 as a preventive measure due to instability in the mine pillars. Securing the mine and modernizing the Camflo mill, where the ore is processed, required an investment of $5 million.

- Campbell Resources Inc. has resumed operations at the Joe Mann mine. The company expects to produce nearly 35 000 oz of gold in 2002 and could produce over 50 000 oz in 2003. It is also mobilizing to restore the Copper Rand property at Chibougamau to production status with a view to starting mining activities in 2004.

- Miramar Mining Corporation and Hope Bay Gold Corporation Inc. have decided to merge. They each held a 50% interest in the Hope Bay property, which contains a number of high-grade gold deposits. The merger will expedite the start of production on these deposits, which are located in Nunavut.

- Two mines ceased operations due to ore depletion: McWatters' Kiena mine and Barrick Gold Corporation's Bousquet mine. McWatters carried out an exploration program at Kiena to identify new economic reserves; it is also looking into the possibility of using the mill to process ore from the nearby East-Amphi property.

- Placer Dome North America and Kinross Gold Corporation have decided to set up a joint venture to which their respective mining properties will be transferred. These properties are in the Porcupine district in Ontario. A subsidiary of Placer Dome will manage the new company, which will operate the Hoyle Pond and Dome mines. The combined production will be around 13 or 14 t/y. Placer Dome will hold 51% of the new company and Kinross will hold 49%.

WORLD OVERVIEW

- Gold-producing companies continued at an even greater pace with their industry consolidation that began a few years ago. Early in the year, Newmont Gold Company acquired Normandy Mining Ltd. of Australia. Later, Placer Dome took possession of Aurion Gold – a new corporation that resulted from the merger in 2001 of two Australian companies, Delta Gold Mining Corp. and Goldfields Limited. There were also mergers or proposals for mergers between TVX Gold Inc., Kinross Gold Corporation and Echo Bay Mines Ltd., between Glamis Gold Ltd. and Francisco Gold Corp., between Repadre Capital Corporation and IAMGOLD Corporation, between Meridian Gold Inc. and Brancote Holdings Plc, and between Bema Gold Corporation and EAGC Ventures Corp.

- Despite all these mergers, the gold sector remains relatively unconcentrated. Over the past five years, the proportion of gold production from the 10 largest producers increased from 47% in 1998 to about 55% in 2002.

- After setting a new record in terms of quantity produced in 2001, global gold mine production began a slow decline that could last for a few years. This drop in production, combined with the buyback of a portion of the mining companies' hedging programs, is the main cause of the rise in the price of gold in 2002. Mine production is expected to be around 2540 t, a reduction of more than 60 t, and, when combined with gold sales and loans by central banks, recycled gold, and sales by investors, results in a global gold supply that will reach nearly 3700 t, a slight decrease from the previous year.

- Demand for gold, mainly from jewellery, electronics and the investment sector, fell slightly in 2002. The significant increase in the price of gold substantially reduced demand from the jewellery sector. This major decrease was offset by the buyback by mining companies of a portion of their hedging programs, which maintained the price of gold at higher levels than had been forecast for 2002. Buyback activities are expected to continue in 2003.

- In 2002, China continued its policy of liberalizing the gold sector in its territory. It now intends to authorize direct participation by foreign corporations in mining and has inaugurated a new exchange in Shanghai where gold will be traded freely, ending 50 years of absolute government control over the price of gold.

- Barrick Gold Corporation has discovered a major deposit on its Alto Chicama property in Peru. The results of initial exploration work indicate gold resources of over 7.3 million oz. The similarities between this deposit and the Pierina deposit, located 175 km from the discovery, already promise a mine with very low production costs. Barrick is confident it can expand these resources even further and is expecting to devote nearly $35 million in exploration expenditures on this property. The property could be brought into production by 2005 at an initial production capacity of 500 000 oz/y.

MARKET OUTLOOK

World mine production, which has been rising for nearly 20 years, began to decline in 2002, thus entering a downward cycle that could last three or four years. The weakness in the price of gold in recent years has led to a drop in exploration expenditures, which in turn has lowered the number of economic deposits discovered. The decline in gold production as a result of mine closures cannot be completely mitigated by mine capacity expansion or by the start-up of production at new deposits. Until 2004, when the *Washington Agreement* expires, gold sales and loans by central banks – another important element in the gold supply – are expected to remain at more or less the same level as in the past two years.

World demand grew more than 35% over the last decade, mainly because weakness in the price of gold led to an increase in demand by jewellers who specialize in gold jewellery. World gold demand for jewellery and electronics is expected to resume its upward trend as soon as economic conditions are favourable again.

CANADIAN PRODUCTION OUTLOOK

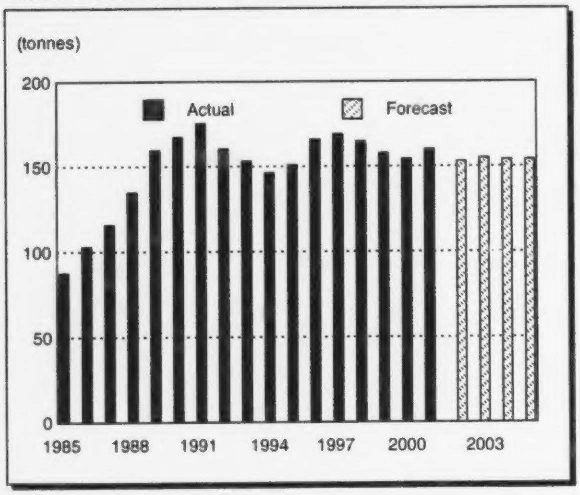
By the end of 2001, Canada had produced over 9300 t of gold since official production was first recorded in 1858 (reference: *Canadian Minerals Yearbook: 1999 Review and Outlook*). Canadian gold production is expected to reach 153 t in 2002, which is 4%, or 7 t, less than in 2001. This production decline is primarily due to closures and the suspension of activities by nine gold producers in 2001. The production start-ups announced in 2002 are expected to result in a net increase of 2-3 t in 2003, even taking the closure of two mines into account. For the following years, mine production is forecast to be between 152 and 155 t. Any significant growth in Canadian gold production over the coming years is expected to come essentially from mine capacity expansions or from the resumption of production at existing mines.

PRICE OUTLOOK

In 2002, the average price of gold began what could become a new upward trend lasting for several years. For 2002, the average price is expected to settle around US$308/troy oz, which compares with US$271/troy oz in 2001 and US$279/troy oz in 2000. The decline in mine production, the stabilization of gold sales from the official sector, and especially the buyback by mining companies of a portion of their hedging programs led to a sustainable price increase that few analysts had anticipated. The drop in demand from jewellery due to the economic slowdown was more than offset by gold purchases under these hedging programs.

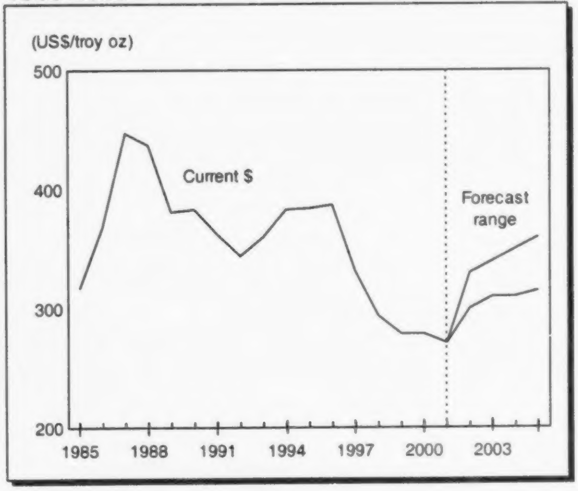
The anticipated decrease in the global gold supply in 2003, combined with stable or slightly increased demand, is expected to continue the pressure to maintain the price of gold within the price range reached in 2002. Over the next few years, the price of gold is forecast to vary between US$310 and US$360/troy oz and could even exceed this maximum for a brief period. A higher price level may be reached if global demand comes under new pressure stemming from the liberalization of the gold trade in China and from possible successes brought on by the advertising campaign begun by gold producers.

Figure 1
Mine Production of Gold in Canada, 1985-2005



Source: Natural Resources Canada.

Figure 2
London Bullion Market Association Gold Prices, 1985-2005



Source: Natural Resources Canada.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of November 30, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

		Canada			United States	EU	Japan (1)
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO
71.08	Gold (including gold plated with platinum) unwrought or in semi-manufactured forms, or in powder form						
	Non-monetary:						
7108.11.00	Powder	Free	Free	Free	Free	Free	Free
7108.12.00	Other unwrought forms	Free	Free	Free	Free	Free	Free
7108.13	Other semi-manufactured forms						
7108.13.10	Of 10 carats or more	Free	Free	Free	Free	Free	Free
7108.13.20	Of less than 10 carats	4%	Free	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001); *Customs Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).
(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, GOLD PRODUCTION AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(grams)	($000)	(grams)	($000)	(grams)	($000)
PRODUCTION							
	Newfoundland and Labrador	1 314 438	17 507	1 454 798	19 353	1 529 859	20 473
	Prince Edward Island	–	–	–	–	–	–
	Nova Scotia	–	–	–	–	–	–
	New Brunswick	221 824	2 954	236 464	3 146	262 983	3 519
	Quebec	37 203 492	495 513	34 498 621	458 935	33 777 000	452 004
	Ontario	76 314 835	1 016 437	71 851 355	955 839	78 612 542	1 051 993
	Manitoba	8 363 801	111 397	7 144 016	95 037	6 706 991	89 753
	Saskatchewan	1 700 801	22 653	1 863 338	24 788	1 513 319	20 251
	Alberta	16 813	224	21 981	292	19 283	258
	British Columbia	24 952 584	332 343	25 129 245	334 294	24 052 735	321 874
	Yukon	4 371 143	58 219	3 980 686	52 955	2 951 434	39 496
	Northwest Territories	3 157 342	42 053	4 507 600	59 965	4 035 360	54 001
	Nunavut	–	–	3 695 820	49 165	4 392 096	58 775
	Total	157 617 073	2 099 302	154 383 923	2 053 769	157 853 602	2 112 397
	Mine output	157 754 746	..	156 207 076	..	159 713 723	..
EXPORTS							
2600.00 (1)	Gold in ores and concentrates	4 449 747	40 748	4 428 479	30 293	3 967 812	16 272
7108,11	Gold powder						
	United States	5 145 973	68 323	6 147 608	81 462	9 087 177	124 227
7108,12	Other unwrought forms						
	United States	143 206 853	1 969 032	146 083 265	2 001 369	125 868 172	1 728 777
	United Kingdom	161 738	2 291	88 403	781	13 012 008	174 543
	Switzerland	687 957	8 675	20 543 683	44 867	2 527 892	35 230
	Mexico	349 765	4 625	387 631	5 379	597 187	10 828
	United Arab Emirates	8 000	109	–	–	713 300	9 364
	Japan	497 656	5 970	2 488 280	32 810	502 656	6 690
	Other countries	4 432 102	57 558	813 319	10 936	–	–
	Total	149 344 071	2 048 260	170 404 581	2 096 142	143 221 215	1 965 432
7108,13	Other semi-manufactured forms						
	United States	31 930 272	394 652	26 021 294	335 053	9 476 313	112 542
	Other countries	9 247	138	3 328	88	–	–
	Total	31 939 519	394 790	26 024 622	335 141	9 476 313	112 542
	Total refined gold exports	190 879 310	2 552 121	207 005 290	2 543 038 165	752 517	2 218 473

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(grams)	($000)	(grams)	($000)	(grams)	($000)
IMPORTS (2)							
2600.00 (3)	Gold in ores and concentrates	6 743 624	69 170	6 042 305	68 379	7 664 946	93 196
7108,11	Gold powder						
	United States	40 027	368	60 529	763	45 741	534
	Italy	6 018	35	1 398	22	2 127	17
	Ghana	50 000	366	23 275	182	1 165	15
	Germany	–	–	–	–	130	2
	Other countries	76 376	541	134 009	1 750	8	. . .
	Total	172 421	1 310	219 211	2 717	49 171	566
7108,12	Other unwrought forms						
	Guyana	13 870 594	175 584	13 144 591	184 419	13 679 561	195 187
	United States	91 436 864	401 675	19 398 673	252 817	13 314 775	121 440
	Suriname	5 488 911	65 490	4 805 918	54 388	4 018 370	47 618
	Nicaragua	–	–	3 268 538	31 531	3 013 280	28 039
	Honduras	1 147 570	8 743	136 000	1 645	2 001 014	16 247
	United Arab Emirates	2 350	31	–	–	1 038 081	8 529
	Netherlands	1 308	7	267 466	3 325	330 746	3 820
	Switzerland	9 108	111	10 965	170	222 263	3 082
	Singapore	–	–	–	–	84 745	1 349
	Jamaica	–	–	–	–	115 649	1 055
	Other countries	7 152 670	42 365	1 297 923	16 654	61 446	844
	Total	119 109 375	694 006	42 330 074	544 949	37 879 930	427 210
7108,13	Other semi-manufactured forms						
	United States	798 714	9 371	925 223	11 984	948 905	11 381
	Switzerland	108 400	1 521	117 594	1 741	119 582	1 858
	Singapore	–	–	–	–	34 467	600
	Italy	82 407	603	44 802	377	12 532	153
	Other countries	591 875	5 296	350 902	3 268	27 042	445
	Total	1 581 396	16 791	1 438 521	17 370	1 142 528	14 437
	Total refined gold imports	127 606 816	781 277	50 030 111	633 415	46 736 577	535 413

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; (p) Preliminary.
(1) Includes HS classes 2603.00.82, 2607.00.82, 2608.00.82, 2616.10.82 and 2616.90.82. (2) Imports from "Other countries" may include re-imports from Canada.
(3) Includes HS classes 2603.00.00.82, 2604.00.00.82, 2607.00.00.82, 2608.00.00.82, 2616.10.00.82 and 2616.90.00.20.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GOLD PRODUCTION BY SOURCE, 1975, 1980 AND 1985-2001

Year	Auriferrous Quartz Mines		Placer Operations		Base-Metal Ores		Total	
	(kg)	(%)	(kg)	(%)	(kg)	(%)	(kg)	(%)
1975	37 530	73.0	335	0.6	13 569	26.4	51 433	100.0
1980	31 929	63.1	2 060	4.0	16 632	32.9	50 620	100.0
1985	67 241	76.8	3 464	4.0	16 857	19.2	87 562	100.0
1986	83 197	80.9	2 802	2.7	16 900	16.4	102 899	100.0
1987	94 723	81.8	4 009	3.5	17 086	14.8	115 818	100.0
1988	112 404	83.4	4 879	3.6	17 530	13.0	134 813	100.0
1989	138 211	86.6	5 354	3.4	15 930	10.0	159 494	100.0
1990	147 355	88.0	3 993	2.4	16 025	9.6	167 373	100.0
1991	153 859	87.8	3 834	2.2	17 589	10.0	175 282	100.0
1992	141 965	88.5	3 469	2.2	14 917	9.3	160 351	100.0
1993	137 346	89.7	3 787	2.5	11 997	7.8	153 129	100.0
1994	133 018	90.8	3 714	2.5	9 696	6.6	146 428	100.0
1995	132 834	88.0	5 303	3.5	12 730	8.4	150 867	100.0
1996	147 052	89.3	3 971	2.4	13 636	8.3	164 660	100.0
1997	155 543	90.7	3 987	2.3	11 949	7.0	171 479	100.0
1998	142 846	86.7	3 098	1.9	18 829	11.4	164 773	100.0
1999	141 467	89.7	3 081	2.0	13 068	8.3	157 617	100.0
2000	139 814	90.6	2 695	1.7	11 874	7.7	154 384	100.0
2001 (p)	143 360	90.8	2 636	1.7	11 858	7.5	157 854	100.0

Source: Natural Resources Canada.
(p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD MINE PRODUCTION OF GOLD, 1993-2001

Country	1993	1994	1995	1996	1997	1998	1999	2000	2001
					(tonnes)				
NORTH AMERICA									
Canada (1)	153	146	151	165	172	165	158	154	157
United States	332	326	319	329	359	364	342	355	335
Total North America	485	472	470	494	531	529	500	509	492
AFRICA									
South Africa	620	584	522	495	493	464	450	428	394
Ghana	41	45	53	50	56	73	78	74	72
Mali	6	6	8	7	18	23	25	30	45
Tanzania	8	7	5	6	5	6	9	17	34
Zimbabwe	21	23	26	27	26	27	30	25	22
Other Africa	35	39	40	40	40	41	42	47	49
Total Africa	731	703	655	624	638	634	634	621	615
LATIN AMERICA									
Peru	27	39	57	65	75	92	129	133	134
Brazil	76	73	67	64	59	55	54	53	51
Chile	39	43	49	56	53	48	48	50	40
Argentina	1	1	1	1	3	20	35	26	31
Mexico	11	14	20	25	26	26	24	27	26
Colombia	26	26	24	23	22	22	21	21	20
Venezuela	11	14	17	20	20	14	12	14	17
Bolivia	12	15	16	15	16	17	15	15	16
Guyana	10	12	9	11	14	15	13	14	14
Other	19	19	26	28	29	30	29	26	28
Total Latin America	233	256	286	308	316	339	381	378	376
ASIA									
Indonesia	52	55	74	93	102	139	152	140	183
Papua New Guinea	62	61	55	54	49	63	65	76	68
Philippines	30	31	29	32	34	35	33	35	32
Japan	9	10	9	9	8	9	9	8	8
Other	19	19	21	21	21	18	17	17	19
Total Asia	172	176	188	208	214	264	276	276	310
Europe	25	27	28	29	27	27	24	20	20
OCEANIA									
Australia	247	255	255	290	313	310	300	296	285
Other	15	15	14	16	16	16	16	15	14
Total Oceania	262	270	269	306	329	326	316	312	299
Total Western World	1908	1903	1895	1968	2058	2117	2131	2116	2112
OTHER COUNTRIES									
China	119	121	133	145	149	160	156	164	173
Russia	165	158	142	133	138	127	138	154	165
Uzbekistan	65	65	67	78	82	80	88	88	85
Kyrgyzstan	1	2	2	4	17	21	20	22	25
Kazakhstan	14	15	15	12	11	9	10	13	15
Mongolia	1	2	4	6	10	9	11	13	14
North Korea	15	14	14	12	9	7	7	7	7
Total other countries	383	380	381	393	420	420	437	468	492
Total world production	2291	2282	2276	2361	2479	2537	2567	2584	2604

Source: Consolidated Gold Fields PLC, "Gold 1997."
(1) Production figures for Canada were obtained from Natural Resources Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, GOLD PRODUCTION, AVERAGE VALUE AND PERCENT OF TOTAL MINERAL PRODUCTION, 1975, 1980 AND 1985-2001

Year	Total Production	Total Value	Average Value (1)	Gold as a Percent of Total Mineral Production
	(kg)	($000)	($/g)	(%)
1975	51 433	270 830	5.27	2.00
1980	50 620	1 165 416	23.02	3.70
1985	87 562	1 219 653	13.93	2.70
1986	102 899	1 689 292	16.42	5.20
1987	115 818	2 204 472	19.03	6.10
1988	134 813	2 331 989	17.30	6.30
1989	159 494	2 315 860	14.52	5.90
1990	167 373	2 407 654	14.38	5.90
1991	175 282	2 338 614	13.34	6.70
1992	160 351	2 141 161	13.35	6.00
1993	153 129	2 284 991	14.92	6.20
1994	146 428	2 448 926	16.86	6.00
1995	150 867	2 557 502	16.95	5.90
1996	164 660	2 799 547	17.00	5.60
1997	171 479	2 527 429	14.74	5.00
1998	164 773	2 312 593	14.04	5.20
1999	157 617	2 099 302	13.32	3.90
2000	154 384	2 053 769	13.30	2.40
2001 (p)	157 854	2 112 397	13.38	2.50

Source: Natural Resources Canada.
(p) Preliminary.
(1) Value is based on average London p.m. fix price for gold.

TABLE 5. GOLD FABRICATION IN DEVELOPED AND DEVELOPING COUNTRIES, 1993-2001

Fabricated Gold	1993	1994	1995	1996	1997	1998	1999	2000	2001
					(tonnes)				
DEVELOPED COUNTRIES									
Carat jewellery	900	897	912	900	963	1 005	978	978	909
Electronics	136	145	158	160	179	165	177	202	137
Dentistry	54	55	59	59	62	57	58	61	60
Other uses	62	64	67	67	66	62	55	54	51
Medals and fake coins	4	4	3	2	3	2	3	2	2
Official coins	98	58	70	47	83	110	115	27	39
Subtotal	1 254	1 224	1 269	1 269	1 348	1 389	1 387	1 329	1 199
DEVELOPING COUNTRIES									
Carat jewellery	1 660	1 730	1 893	1 956	2 388	2 152	2 161	2 200	2 096
Electronics	42	44	46	49	56	60	70	81	66
Dentistry	10	9	8	8	8	7	8	8	8
Other uses	38	41	44	47	49	45	45	50	51
Medals and fake coins	21	23	32	31	38	46	43	56	52
Official coins	24	14	17	16	16	17	18	20	17
Subtotal	1 793	1 860	2 039	2 106	2 556	2 326	2 345	2 415	2 291
TOTAL									
Carat jewellery	2 560	2 627	2 805	2 856	3 351	3 157	3 139	3 178	3 005
Electronics	178	189	204	209	235	225	247	283	203
Dentistry	64	64	67	67	70	64	66	69	68
Other uses	100	105	111	114	115	107	100	104	102
Medals and fake coins	25	27	35	33	41	48	46	58	54
Official coins	122	72	87	63	99	127	133	47	56
Total gold fabrication	3 047	3 084	3 308	3 342	3 911	3 726	3 731	3 739	3 490

Source: Consolidated Gold Fields PLC, "Gold 1997."
Note: Numbers may not add to totals due to rounding.

TABLE 6. AVERAGE ANNUAL GOLD PRICES, 1934-99, AND MONTHLY, 1998-99

Year	US$/oz	C$/oz	Year	US$/oz	C$/oz
1934-67	35.00	. .	1985	317.35	433.21
1968	38.82	41.82	1986	367.58	510.73
1969	41.13	44.29	1987	446.66	592.18
1970	35.97	37.54	1988	436.45	554.76
1971	40.87	41.27	1989	381.27	451.33
1972	58.22	57.66	1990	383.72	447.79
1973	97.22	97.24	1991	362.34	415.09
1974	158.80	155.36	1992	343.86	415.23
1975	160.96	163.76	1993	360.06	464.35
1976	124.78	123.01	1994	384.15	524.60
1977	147.80	157.10	1995	384.07	526.94
1978	193.51	220.74	1996	387.69	528.62
1979	305.69	358.12	1997	328.41	454.52
1980	614.38	719.08	1998	294.11	435.77
1981	459.22	550.57	1999	278.86	413.57
1982	375.52	463.51	2000	279.11	414.70
1983	423.52	521.82	2001	271.40	403.08
1984	360.63	466.99	2002	309.73	486.40

Month	1998		1999		2000		2001		2002	
	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)	(US$/oz)	(C$/oz)
January	289.26	416.53	287.31	436.48	284.32	411.95	265.49	399.06	281.65	450.73
February	297.74	425.77	287.5	430.47	299.94	435.24	261.86	398.50	295.50	471.56
March	295.87	420.14	286.24	434.37	286.39	418.30	263.03	409.91	294.05	466.66
April	308.56	441.24	282.62	417.83	279.86	410.95	260.48	405.70	302.68	478.66
May	298.95	430.49	276.93	404.87	275.31	411.73	272.35	419.83	314.49	487.37
June	292.22	426.64	261.40	384.02	285.73	421.97	270.23	411.94	321.18	491.95
July	292.89	436.41	256.20	381.43	281.55	416.10	267.53	409.43	313.29	484.31
August	284.23	434.87	256.94	383.43	274.47	406.89	272.39	419.54	310.25	486.44
September	288.67	438.78	264.47	390.57	273.68	406.73	283.42	444.32	319.16	502.93
October	296.48	456.58	311.56	460.27	270.00	408.32	293.06	460.46	316.56	499.47
November	294.24	453.13	293.65	430.93	266.01	410.24	276.16	439.76	319.15	501.51
December	291.34	448.66	283.74	418.03	271.45	413.26	275.85	435.15	332.43	518.36

Source: London Bullion Market Association, a.m. fix.

. . Not available.

Gypsum and Anhydrite

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GYPSUM

Canadian shipments of natural gypsum totaled 8.1 Mt valued at $96.4 million in 2001, based on preliminary data (Table 1). This amount compares to 8.6 Mt valued at $105.7 million in 2000, based on final data. The reported 8.5% decrease in shipments resulted mainly from reduced shipments to selected market regions in the United States, based on preliminary data from Statistics Canada and the Gypsum Association. In addition to shipments of natural gypsum in 2001, domestic shipments of commercial-quality, synthetic, flue-gas desulphurization (FGD) gypsum from coal-fired generating stations are estimated to be about 380 000 t/y. Total use of FGD in Canada, including imports, is estimated to be 530 000 t/y.

Canadian Industry

Most producers of natural gypsum in Canada are closely integrated in both mining and wallboard manufacturing. Five companies operate ten mines and a total of thirteen wallboard plants accounting for an estimated 1900 employees. The major gypsum mining and related production plants are listed in Table 2. In addition, two companies produce FGD gypsum for the manufacture of wallboard in Canada. These are: 1) Ontario Power Generation Inc. (OPG), which sells its product under long-term contract to Westroc Industries Ltd., located near Toronto, Ontario; and 2) NB Power (Belledune Generating Station) in New Brunswick, which sells its product to CGC Inc. in Montréal, Quebec. (Both OPG and NB Power use the wet limestone system for recovering FGD gypsum.)

In Atlantic Canada, Nova Scotia accounts for 82% of Canada's output of natural gypsum and nearly all of its exports. Most gypsum deposits being mined in the Atlantic provinces are characterized by their high quality, amenability to inexpensive mining methods, and close access to coastal bulk-shipping facilities.

Georgia-Pacific Corporation, operating in Nova Scotia, continued work to develop its new gypsum mine at Melford, Cape Breton, to eventually replace its current operation in this region.

In New Brunswick, Plaster Rock Gypsum and Manufacturing Company supplied agricultural markets from its gypsum crushing plant in Plaster Rock.

In Quebec, most demand for gypsum is satisfied by shipments of raw material, including synthetic gypsum from Atlantic Canada.

In Ontario, developments remained essentially the same; however, in Manitoba, Georgia-Pacific Corporation, as part of its rationalization plan in North America, closed its gypsum mine in Amaranth and its wallboard manufacturing plant in Winnipeg.

World Developments and Trade

Natural gypsum is by far the most important source of raw material for this mineral's many uses. However, synthetic gypsum produced mainly by the FGD process accounts for 4-5% of the total combined output of crude and commercial-quality synthetic gypsum produced in Canada.

Stricter environmental regulations worldwide have acted as a driver to reduce sulphur dioxide regulations in many countries. In the United States, of 19 newly built plants or expansions since 1998, nearly all use synthetic (mainly FGD) gypsum. The production of synthetic gypsum in the United States is estimated to be 6.1 Mt, accounting for about 25% of the combined output of crude and synthetic gypsum, or about 18% of the apparent use. (This amount represents a twofold increase in the production of synthetic gypsum during the five-year period from 1997 to 2001, according to the U.S. Geological Survey [USGS]).

World production of gypsum in 2001 is an estimated 109 Mt, based mainly on USGS sources (Office of

Minerals Information's web site at www.usgs.gov). The United States ranked number one with production of 18.8 Mt, followed by Iran, 11.0 Mt; Canada, 8.1 Mt; Mexico, 7.6 Mt; and Spain, 7.5 Mt.

Canada's imports of gypsum from the United States and Mexico (Table 1) are used by both wallboard and cement manufacturers. Imports from Spain, however, are reportedly for use only by specific cement manufacturers.

In the United States, the construction of several major new plants and expansions designed to use only synthetic gypsum continued during 2001.

Processing and Markets

The gypsum wallboard industry mainly serves the residential, institutional and commercial building sectors. In North America, wallboard manufacturing accounts for an estimated 75% of gypsum use, cement processing accounts for 10-15%, and agriculture and industrial processes account for the remainder of uses.

Canadian wallboard plants in 2001 shipped about 294 million m^2 (3.16 billion square ft) of finished products compared to about 280 million m^2 in 2000, according to Statistics Canada.

Shipments of wallboard by U.S. producers in 2001 were 2.73 billion m^2 (29.34 billion square ft), according to the Gypsum Association. (This amount represents an increase of approximately 4% compared to the previous 12-month period.)

The Portland cement industry requires crushed, non-calcined gypsum acting as a set regulator in a proportion up to 5% by total weight. This mineral is ground with the primary stage clinker to produce a secondary stage cement powder for use mainly in concrete products. Based on this proportion of gypsum, the total amount of gypsum required by cement producers in Canada is estimated to be 500 000-550 000 t/y.

Other uses for gypsum relate mainly to agriculture as a soil conditioner and as a mineral filler in joint compounds, plastics and paints, and in certain glass-making technologies.

A portion of the gypsum waste generated annually by wallboard manufacturing, installation and demolition is recycled. Although data are not available, it is estimated that 100 000-200 000 t/y of gypsum are recycled; this amount would represent 5-10% of the gypsum used for making wallboard in Canada.

Process Research ORTECH Inc. sponsored Gypsum and Fly Ash 2002 – 7th International Science and Technology Conference and Short Course, held in Toronto in June 2002. This series of conferences has contributed greatly to improving communication and the dissemination of new information among power utilities and other synthetic gypsum producers, users, and equipment suppliers. Also, with renewed interest in the importance of fly ash as a major coal combustion product (CCP) used as a supplementary cementing material (SCM) to partially replace energy-intensive Portland cement, this conference attracted a wide range of delegates. (The use of CCPs in Canada is highlighted in a separate commodity chapter entitled *Cement*, refer to Table 4.)

Prices

Prices for gypsum in merchant markets are negotiated among buyers and sellers, and published figures are not always relevant. In Canada, the average reported value for crude gypsum, f.o.b. mine, is about $11.60/t for the five-year period from 1997 to 2001.

Outlook

Canadian shipments of gypsum in 2002 are expected to be higher, based mainly on lower interest rates, continuing economic growth, and an increase in residential construction. In Canada, housing starts were 150 000 in 1999, 151 653 in 2000, and 162 733 in 2001; starts in 2002 are forecast to be about 200 000, according to the Canada Mortgage and Housing Corporation. However, the values of building permits in the commercial and institutional sectors during mid-2002 were weaker than at the same time in 2001.

Diverse uses of gypsum related to building plasters, Portland cement, fillers and pigments, soil conditioners, and fertilizers as a diluent are important and tend to expand with overall economic growth. The present structure of the industry in Canada is not expected to change significantly, although the future availability of low-cost synthetic gypsum resulting from more strenuous emission controls may serve to increase demand for this mineral.

Based on a recent study, FGD systems to capture sulphur dioxide from power plant stacks may double by 2006. In addition, it has been stated that limestone wet scrubbing with a gypsum by-product will continue to be the leading desulphurization technology used on all continents. However, lime-based systems and ammonia scrubbers will also be important (www.mcilvainecompany.com).

ANHYDRITE

Production and trade statistics for anhydrite are included with gypsum. Anhydrite, the anhydrous form of gypsum (about twice as hard and also denser than gypsum), is produced by Fundy Gypsum Company at Wentworth, Nova Scotia, and by Little Narrows Gypsum Company at Little Narrows, Nova Scotia.

Shipments of anhydrite in 2000 were about 200 000 t, mainly to the United States for use as a peanut crop fertilizer, and to Quebec and Ontario for final-stage processing of Portland cement. Similarly, shipments in 2001 were an estimated 125 000 t, according to the Nova Scotia Department of Natural Resources.

Test work on the use of anhydrite in floor screed and suspended floor systems, comprising part of an earlier Canada-Nova Scotia cooperative mineral development project, showed promise as new uses for Canadian gypsum. Similarly, testing of anhydrite (in combination with water and special chemicals) as a mine "pack" construction material to improve underground support in coal mines has been encouraging.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 30, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2520.10	Gypsum; anhydrite	Free	Free	Free	Free
2520.20	Plasters	Free	Free	Free	Free
68.09	Articles of plaster or of compositions based on plaster; Boards, sheets, panels, tiles and similar articles, not ornamented				
6809.11	Faced or reinforced with paper or paperboard only				
6809.11.10	Gypsum wallboard	6%	Free	Free	Free
6809.11.90	Other	6%	Free	Free	Free
6809.19.00	Other	6.5%	6.5%	Free	Free
6809.90	Other articles				
6809.90.10	Models and casts, of a kind used in the manufacture of dental prostheses	Free	Free	Free	Free
6809.90.90	Other	6.5%	3%	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, GYPSUM PRODUCTION AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)							
	Crude gypsum						
	Newfoundland and Labrador	x	x	x	x	x	x
	Nova Scotia	7 483 604	83 637	6 953 440	81 337	6 677 908	76 034
	Ontario	x	x	x	x	x	x
	Manitoba	x	x	x	x	x	x
	British Columbia	x	x	x	x	x	x
	Total (1)	9 345 342	106 634	8 572 464	105 655	8 119 233	96 436
IMPORTS							
2520.10	Gypsum, anhydrite						
	United States	83 336	9 220	78 882	10 240	155 897	12 232
	Mexico	37 514	2 353	75 673	1 763	87 204	1 424
	United Kingdom	83	122	30	16	–	–
	Brazil	89	127	–	–	–	–
	Other countries	26	21	19	26	59	19
	Total	121 048	11 843	154 604	12 045	243 160	13 675
2520.20	Gypsum; anhydrite; plasters						
	United States	28 609	9 619	36 194	11 197	36 916	11 960
	Japan	73	64	122	106	256	168
	Australia	–	–	–	–	78	96
	Germany	31	24	51	46	76	70
	Italy	(r) 20	(r) 18	132	82	68	49
	Ecuador	–	–	–	–	71	23
	Mexico	30	8	114	21	–	. . .
	Other countries	126	73	100	47	104	40
	Total	(r) 28 889	(r) 9 896	36 713	11 499	37 570	12 406
		(n.a.)	**($000)**	**(n.a.)**	**($000)**	**(n.a.)**	**($000)**
6809.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	. .	5 152	. .	7 475	. .	15 495
	Sweden	–	–	. .	. . .	. .	90
	United Kingdom	. .	1 988	. .	35	. .	83
	Singapore	–	–	–	–	. .	72
	Germany	. .	1 897	. .	1	. .	18
	Poland	. .	1 931	–	–	–	–
	Other countries	. .	10	. .	60	. .	5
	Total	. .	10 978	. .	7 571	. .	15 763
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	9 469	. .	10 822	. .	13 267
	Mexico	. .	. . .	. .	. . .	. .	134
	France	. .	. . .	. .	. . .	. .	59
	Other countries	. .	33	. .	50	. .	52
	Total	. .	9 502	. .	10 872	. .	13 512
6809.90	Articles of plaster or compositions based on plaster						
	Mexico	. .	557	. .	1 531	. .	2 639
	United States	. .	4 293	. .	3 525	. .	2 000
	China	. .	448	. .	559	. .	1 140
	United Kingdom	. .	601	. .	507	. .	245
	Other countries	. .	168	. .	147	. .	196
	Total	. .	6 067	. .	6 269	. .	6 220
	Total imports of gypsum and gypsum products	. .	(r) 48 196	. .	48 256	. .	61 576
		(tonnes)	**($000)**	**(tonnes)**	**($000)**	**(tonnes)**	**($000)**
EXPORTS							
2520.10	Gypsum, anhydrite						
	United States	6 224 766	88 343	6 318 451	97 430	5 596 557	83 356
	Japan	–	–	171	11	–	–
	Other countries	64	18	64	3	–	–
	Total	6 224 830	88 361	6 318 686	97 444	5 596 557	83 356

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2520.20	Gypsum; anhydrite; plasters						
	United States	1 791	946	765	651	2 118	1 897
	Cuba	–	–	–	–	79	119
	China	–	–	–	–	21	55
	Bermuda	21	14	74	45	21	11
	France	–	–	90	73	–	–
	Other countries	23	13	69	39	27	18
	Total	1 835	973	1 007	808	2 266	2 100
		(square metres)		**(square metres)**		**(square metres)**	
6810.11	Plasterboards, etc., not ornamental; faced or reinforced with paper or paperboard						
	United States	134 337 396	300 984	73 254 228	129 152	73 074 740	117 665
	Cuba	150 092	353	14 017	35	24 040	87
	Saint Kitts and Nevis	33 200	84	–	–	29 680	74
	Bermuda	3 109	12	10 300	26	13 180	33
	Latvia	–	–	4 672	8	7 031	32
	Saint Pierre and Miquelon	14 352	24	8 767	6	7 949	26
	Taiwan	–	–	–	–	6 907	21
	France	–	–	–	–	590	16
	Trinidad and Tobago	10 600	33	32 658	81	5 308	16
	Argentina	–	–	–	–	3 329	8
	Japan	11 100	28	–	–	440	3
	South Korea	5 206	13	–	–	–	–
	Australia	24 300	67	–	–	–	–
	New Zealand	9 807	17	–	–	–	–
	Guyana	1 543	4	–	–	–	–
	Chile	10 600	27	513	4	–	–
	Venezuela	42 100	106	–	–	–	–
	Barbados	43 700	110	–	–	–	–
	Namibia	4 170	10	–	–	–	–
	Croatia	12 400	31	5 400	14	–	–
	Saint Lucia	12 200	31	–	–	–	–
	Saint Vincent and the Grenadines	1 920	5	–	–	–	–
	Czech Republic	9 600	24	–	–	–	–
	Netherlands Antilles	21 150	53	–	–	–	–
	Aruba	21 010	53	–	–	–	–
	Hungary	–	–	12 122	47	–	–
	Portugal	10 400	26	19 000	48	–	–
	Saudi Arabia	–	–	26 155	65	–	–
	Hong Kong	–	–	26 042	50	–	–
	India	–	–	4 950	12	–	–
	Germany	11 400	28	14 900	37	–	–
	United Kingdom	11 664	29	–	–	–	–
	China	7 900	20	17 200	43	–	–
	Total	134 820 919	302 172	73 450 924	129 628	73 173 194	117 981
		(n.a.)	**($000)**	**(n.a.)**	**($000)**	**(n.a.)**	**($000)**
6809.19	Plasterboards, etc., not ornamental; faced or reinforced, n.e.s.						
	United States	. .	39 230	. .	28 110	. .	29 694
	Chile	. .	168	. .	269	. .	491
	Finland	–	–	. .	9	. .	126
	Japan	–	–	–	–	. .	94
	Cuba	–	–	. .	139	–	–
	Other countries	. .	124	. .	71	. .	121
	Total	. .	39 522	. .	28 598	. .	30 528
6809.90	Articles of plaster or compositions based on plaster						
	United States	. .	29 572	. .	29 759	. .	35 570
	Finland	. .	110	. .	123	. .	56
	United Kingdom	. .	79	. .	62	. .	52
	Bermuda	. .	13	. .	21	. .	50
	Bahamas	. .	432	–	–	. .	47
	United Arab Emirates	. .	360	. .	22	–	–
	Other countries	. .	226	. .	115	. .	98
	Total	. .	30 792	. .	30 102	. .	36 873
	Total exports of gypsum and gypsum products	. .	461 820	. .	286 580	. .	269 836

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.a. Not applicable; n.e.s. Not elsewhere specified; (p) Preliminary (r) Revised; x Confidential.
(1) Totals do not include gypsum produced or shipped for use by Canadian Portland cement producers.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, GYPSUM MINING AND GYPSUM PRODUCTS MANUFACTURING OPERATIONS, 2001

Company	Location	Operation
NEWFOUNDLAND AND LABRADOR		
Lafarge Gypsum Canada Inc.	Fischells Brook	Open-pit mining
	Corner Brook	Wallboard manufacture
NOVA SCOTIA		
CGC Inc.	Port Hawkesbury	Fibre-gypsum board manufacture
Fundy Gypsum Company	Wentworth and Miller Creek	Open-pit mining of gypsum and anhydrite
Georgia-Pacific Corporation	Sugar Camp	Open-pit mining
Little Narrows Gypsum Company	Little Narrows	Open-pit mining of gypsum and anhydrite
National Gypsum (Canada) Ltd.	Milford	Open-pit mining
NEW BRUNSWICK		
Westroc Inc.	McAdam	Wallboard manufacture
QUEBEC		
CGC Inc.	Montréal	Wallboard manufacture
	Saint-Jérôme	Wallboard plant mothballed
Georgia-Pacific Corporation	Montréal	Distribution terminal only
Westroc Inc.	Montréal	Wallboard manufacture
ONTARIO		
CGC Inc.	Hagersville	Underground mining and wallboard manufacture
Georgia-Pacific Corporation	Caledonia	Underground mining and wallboard manufacture
Westroc Inc.	Clarkson	Wallboard manufacture
MANITOBA		
Westroc Inc.	Amaranth	Open-pit mining
	Winnipeg	Wallboard manufacture
ALBERTA		
Georgia-Pacific Corporation	Edmonton	Wallboard manufacture
Westroc Inc.	Calgary	Wallboard manufacture
BRITISH COLUMBIA		
Georgia-Pacific Corporation	Canal Flats	Open-pit mining
	Vancouver	Gypsum products manufacture
Westroc Inc.	Vancouver	Gypsum products manufacture
	Windermere	Open-pit mining

Source: Natural Resources Canada.

TABLE 3. CANADA, GYPSUM PRODUCTION, TRADE AND USE, 1980 AND 1985-2001

	Production (1)	Imports (2)	Exports	Apparent Use (3)
		(tonnes)		
1980	7 336 000	154 717	4 960 240	2 530 477
1985	7 760 783	121 802	5 879 664	2 002 921
1986	8 802 805	221 644	5 921 982	3 102 467
1987	9 093 926	217 625	5 704 853	3 606 698
1988 (a)	8 813 760	274 917	5 651 286	3 437 391
1989	8 179 588	291 373	5 357 055	3 113 906
1990	7 977 685	318 114	5 757 327	2 538 472
1991	6 727 221	259 863	4 940 193	2 046 891
1992	7 294 700	260 505	5 010 649	2 544 556
1993	7 563 369	280 581	5 315 618	2 528 332
1994	8 587 303	292 156	5 942 572	2 936 887
1995	8 054 741	177 327	5 565 427	2 666 641
1996	8 201 774	247 208	5 526 010	2 922 972
1997	8 627 772	220 914	5 981 974	2 866 712
1998	8 306 534	96 593	5 552 146	2 850 981
1999	9 345 342	121 048	6 224 830	3 241 560
2000	8 572 464	154 604	6 318 686	2 408 382
2001 (p)	8 119 233	243 160	5 596 557	2 765 836

Sources: Natural Resources Canada; Statistics Canada.

(p) Preliminary.

(a) Beginning in 1988, imports and exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS class 2520.10.00 (gypsum, anhydrite).

(1) Producers' shipments of crude gypsum. (2) Includes crude and ground, but not calcined. (3) Production plus imports minus exports.

TABLE 4. CANADA, VALUE OF CONSTRUCTION BY TYPE, 1996-2001

	1996	1997	1998	1999	2000	2001
			($ billions)			
BUILDING CONSTRUCTION						
Residential investment	32.3	36.5	36.0	38.8	40.8	43.6
Non-residential building investment	19.6	22.5	22.4	24.2	25.3	26.3
Total building construction	51.9	59.0	58.4	63.0	66.1	69.9
ENGINEERING CONSTRUCTION						
Mining and oil and gas extraction	13.9	18.2	16.7	15.4	19.3	21.1
Transportation and warehousing	2.0	2.2	5.0	5.0	4.1	3.4
Other engineering	15.2	14.7	14.5	16.6	18.3	18.9
Total engineering construction	31.1	35.1	36.2	37.0	41.7	43.4
Total all components	83.0	94.1	94.6	100.0	107.8	113.3

Sources: Natural Resources Canada; Statistics Canada, CANSIM II (Table 026-0013 – Residential Values, by Type of Investment and Related Table 031-0002 – Flows and Stocks of Fixed Non-Residential Capital, by North American Industry Classification System). (More information can be obtained on the Internet at the CANSIM II site at www.statcan.ca/english/CANSIM.)

Notes: Numbers may not add to totals due to rounding. Residential construction includes value of new construction, renovations and acquisition costs.

TABLE 5. WORLD PRODUCTION OF GYPSUM, 2000 AND 2001

	2000	2001(e)
	(000 tonnes)	
Canada	8 570	8 100
Australia	3 800	4 000
China	6 800	6 800
France	4 500	4 500
India	2 210	2 220
Iran	11 000	11 000
Japan	5 600	6 000
Mexico	7 000	7 600
Spain	7 500	7 500
Thailand	6 000	6 000
United Kingdom	1 500	1 400
United States	19 500	18 800
Other countries	22 200	24 900
Total world	106 180	108 820

Sources: Natural Resources Canada; U.S. Geological Survey, January 2002.
(e) Estimated.

Indium

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Note: This is a brief review of indium in Canada with general information about indium and not a comprehensive review of indium metal.

The chemical symbol for indium is In.

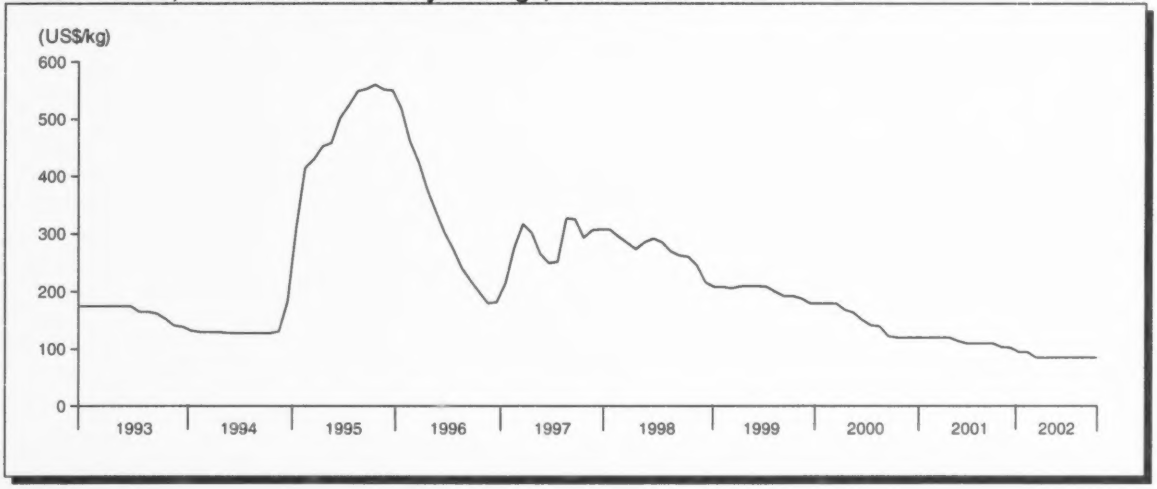
WORLD CONTEXT

Indium is the by-product of the mining and processing of zinc. The United States Geological Survey (USGS) estimated that world production of refined indium in 2001 was about 340 t. The top five producers accounted for 88% of estimated world production in 2001. Chinese production has increased dramatically since 1999. The production of refined indium over time, which includes indium from recycled sources, is shown in Figure 1.

The most significant application for indium continues to be use as a coating for display screens used in computers and other electronic devices such as cell phones, instrumentation panels, CD players, etc. Indium is used in the form of an indium tin oxide, or ITO, which is transparent and electrically conductive. The ITO is "sputtered" onto glass targets. The sputtering process to deposit ITO onto targets is inefficient and results in a large number of rejects that are unsuitable for display screens. These rejects were left in stockpiles on the sites of many producers but, during the period of high prices for indium in the mid-1990s, manufacturers, especially in Japan, had a great incentive to develop ways to recycle the materials. In addition, manufacturers could invest in ways to decrease the rejection rate for the sputtering

Figure 1

Indium Prices, Metal Bulletin Monthly Average,[1] 1993-2002



Source: *Metal Bulletin.*

[1] Average of *Metal Bulletin's* monthly low and high prices, European price, in warehouse, ingots min. 99.97%.

targets. Together these measures allowed manufacturers to make more efficient use of indium.

According to press reports citing Roskill Information Services Ltd., supply potential also increased as producers increased recovery rates of indium from smelter flue dusts and residues at lead-zinc metallurgical plants to take advantage of higher prices. Reportedly, the recovery rate went from 30% to 80% in places, with improvements noted at Teck Cominco Limited's Trail operation, at Falconbridge Limited's Kidd Creek operation, and at Japanese producers. The other important supply factor has been the significant increase in Chinese production.

According to information released to the press in November 1999 and posted on the Roskill web site, Roskill (see below for details) estimated that demand for indium in 1998 was about 200 t. Of this, over half was used in ITO applications for electronics. Roskill forecasts the use of indium in electronic applications will rise to about 150 t by 2005. Other important indium-using sectors in 1998 were low-melting-point alloys, using 31 t, and semiconducter applications, using 19 t. Roskill predicted that the solar cell industry will use increasing quantities of copper-indium-diselenide.

CANADIAN DEVELOPMENTS

Canadian indium production statistics are withheld for confidentiality reasons. Domestic production of indium is derived from the processing of zinc ores. Two facilities in Canada recover indium: Teck Cominco Limited's operation at Trail, British Columbia, and Falconbridge Limited's Kidd Creek operation in Timmins, Ontario. According to the USGS, Canada accounted for about 15% of the world's indium production in 2001. The USGS estimates that Canada has the largest reserve and resource base, accounting for 27% and 35%, respectively.

Teck Cominco Limited <www. teckcominco.com> recovers indium from the zinc-lead feed to its smelter in Trail, British Columbia. Lead smelter slag fume dust containing indium is collected and sent to the zinc facilities on site for further separation and is then sent to the high-purity indium plant.

Teck Cominco produces high-purity indium needed to make indium-tin oxide suitable for use in the electronics industry. A press report in early January 1995 indicated that the company was then producing at a rate of about 20 t/y (or two thirds of its then capacity of 30 t/y) and that production would increase during 1995. The company does not comment on its indium production rate or its capacity to produce indium. Feed from the stockpile began in mid-1999 and the company had estimated that it would be completely processed over a period of four years. Teck Cominco is examining the potential for value-added production for its indium output.

The Kidd Metallurgical Division of **Falconbridge Limited** <www.falconbridge.com> in Timmins, Ontario, recovers indium from copper and zinc production. The indium is recovered from copper smelter flue dusts and is sent for recovery at a special indium recovery operation on site where indium is recovered as refined material. In late 1998 when Kidd experienced problems with its copper converter, a spokesperson put its annual indium production rate at about 22 t.

Kidd increased the purity of its material in the late 1990s. Falconbridge's annual report in 1999 stated that Noranda Inc. had become the sales agent for indium sales from Falconbridge. As of July 2002, Noranda owned 58.4% of the common shares of Falconbridge.

Indium Properties in Canada

Mt. Pleasant was operated by Billiton Metals Canada as a tungsten operation during the first half of the 1980s, but closed because of low metal prices. From 1995 to 1996, **Adex Mining Corp.** evaluated the Mt. Pleasant property in New Brunswick. Adex took bulk samples and undertook a metallurgical research program at the site of the former mine as part of a feasibility study for tin and indium production. The high capital cost estimate and the low indium prices in 1997 meant that Adex was not able to develop the orebody. Adex was delisted in June 1999. The company did not maintain a web site at the time this article was written.

PRICES

Indium prices from 1993 to 2000 are shown in Figure 1. During the two-year price surge from early 1995 to early 1997, manufacturers began recycling their off-specification material and producers concentrated on increasing recovery rates. The price history since that time indicates that supply and demand have generally been in balance.

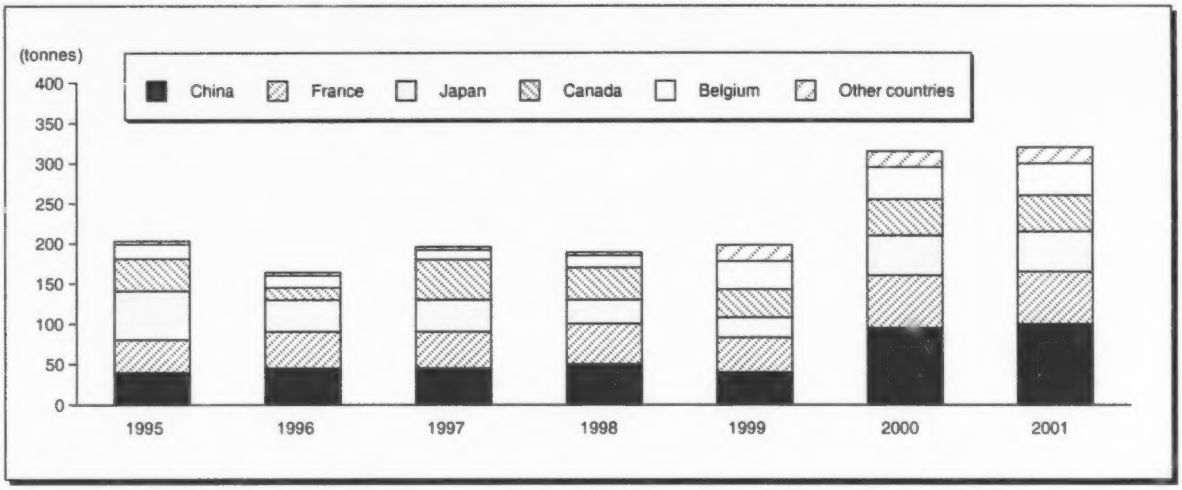
PRODUCT INFORMATION

Those who wish to purchase indium should contact the producers. In Canada these are:

• Cominco Ltd.	<www.cominco.com>
• FalconbridgeLimited	<www.falconbridge.com>

Additional information such as addresses and phone numbers are listed on their respective web sites.

Figure 2
World Refined Indium Production, 1995-2001



Source: United States Geological Survey estimates.

Information about various indium products such as solders, sputtering targets, compounds, and alloys can be found at a number of web sites, including the following:

- Indium Corporation of America <www.indium.com>

INTERNET INFORMATION SOURCES

Additional sources of information available on the Internet, current to January 2002, include the following:

- United States Geological Survey (USGS): <http://minerals.usgs.gov/minerals/pubs/commodity/indium>
- Search by company name in the SEDAR data base for companies publicly traded in Canada: <www.sedar.com/search/search_form_pc_en.htm>
- *Canadian Mining Journal* (choose "Index and Archives" to see back issues): <www.canadianminingjournal.com>
- *Northern Miner* (daily headlines): <www.northernminer.com>
- Various on-line encyclopedias
- Any web search engine such as <www.google.com/advanced_search>
- For physical and chemical properties, concentrations in various media, etc.: <www.webelements.com/webelements/elements/text/In/key.html>
- *American Metal Market*, search (some articles do not require paid subscription to access): <www.amm.com>
- *Mining Journal*, search (some articles do not require paid subscription to access): <www.mining-journal.com/index1.htm>
- *Metal Bulletin* (information by paid subscription): <www.metalbulletin.co.uk>

COMMERCIALLY AVAILABLE INFORMATION

More detailed information is available for purchase from Roskill Information Services in the United Kingdom. Further information is available at the company's web site at www.roskill.co.uk/indium.html.

Studies from other sources may be available.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 27, 2002. (3) This article is not intended to be a comprehensive overview of the indus-

try but, rather, is a brief report to provide information about Canadian developments in the world indium industry. More detailed information is available from the United States Geological Survey, whose web site is noted above. (4) The web sites listed here are exterior to Natural Resources Canada and may not be available in both English and French. The content of these sites is entirely determined by their owners. (5) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
8112.92	Unwrought; waste and scrap; powder				
8112.92.90.13	Unwrought indium, not alloyed; powders, not alloyed	2%	Free	Free	Free
8112.92.90.23	Unwrought indium, alloyed; waste and scrap; powders, alloyed	2%	Free	Free	Free
8112.92.90.30	Indium and articles thereof, n.e.s.	3%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.
n.e.s. Not elsewhere specified.

TABLE 1. CANADA, INDIUM PRODUCTION AND IMPORTS, 1999-2001

Item No.		1999 (kg)	1999 ($000)	2000 (kg)	2000 ($000)	2001 (p) (kg)	2001 (p) ($000)
MINERAL PRODUCTION		x	x	x	x	x	x
IMPORTS							
8112.91.90.13	Unwrought indium, alloyed; waste and scrap; powders, alloyed						
	China	734	126	1 998	345	2 524	435
	United States	920	157	3 158	541	1 422	242
	Germany	1	. . .	21	3	4	1
	United Kingdom	122	21	–	–	–	–
	France	2 829	616	–	–	–	–
	Total	4 606	920	5 177	889	3 950	678
8112.91.90.23	Indium unwrought metal; powders						
	China	30	5	1 404	243	3 621	624
	United States	142	24	5	1	515	89
	United Kingdom	244	42	–	–	–	–
	Japan	12	2	–	–	–	–
	Total	428	73	1 409	244	4 136	713

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
Notes: Indium export statistics are included with certain other metals as a total and are therefore not available. Numbers may not add to totals due to rounding.

Iron Ore

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There are two aspects to iron ore demand: quantity and quality. Since the major trade item is in mineral rather than metallic form, there are many chemical and physical variants of iron ore, but they all serve the same purpose – providing the iron component of steel. Steel production in turn is the driving force for almost all iron ore demand. In spite of the introduction of many new materials in this century, worldwide steel industry growth has tended to average about 1% per year over the long term and this trend is expected to continue. However, technological changes at all stages from iron ore mining through to the production of finished steel have been major factors in determining the quantities and properties of the iron ore demanded.

CANADIAN DEVELOPMENTS

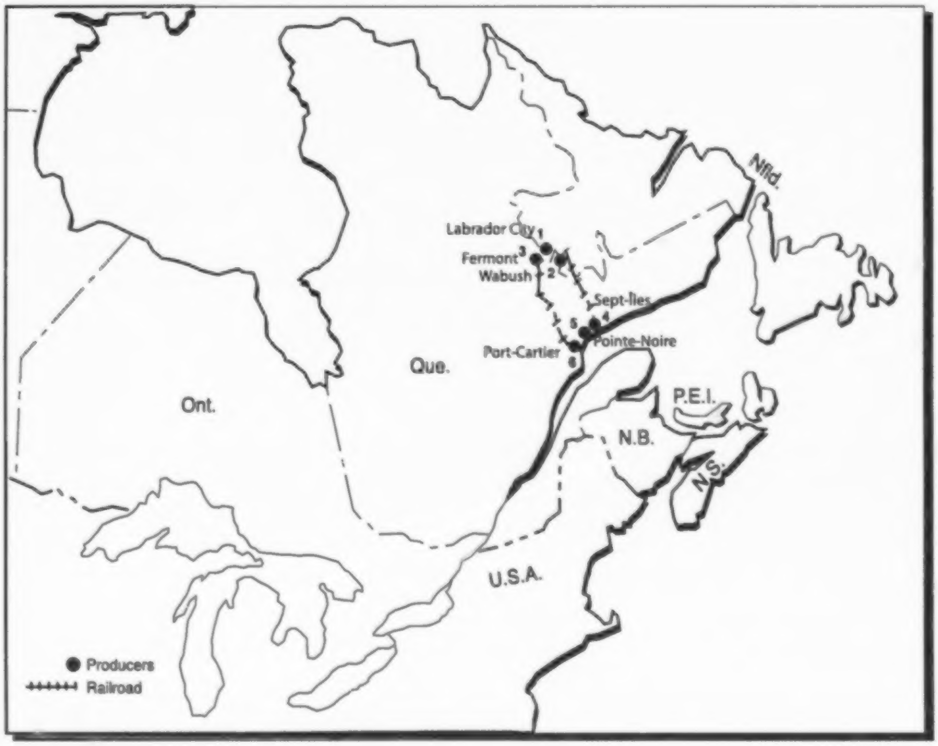
Iron ore is one of Canada's single most important mineral products in terms of both tonnage and in value. Since the closure in 1998 of the **Algoma Iron Ore Division** near Wawa, Ontario, nearly all of Canada's iron ore production has been concentrated in the Labrador Trough, a major geological belt extending through northern Quebec and Labrador. Canada's production in this area (Figure 1) comes from three mining operations owned by **Iron Ore Company of Canada (IOC)**, **Quebec Cartier Mining Company (QCM)**, and **Wabush Mines**. The remaining production comes from the by-product recovery of magnetite from two base-metal smelters in British Columbia.

In 2001, as a result of the global economic slowdown (particularly the depressed demand from the North American steel industry), Canada's iron ore production slumped to slightly less than 27.0 Mt, a decrease of 23.5% compared to the previous year. In line with this reduction, the value of Canada's production fell by 18.9% to $1.16 billion. Likewise, Canada's iron ore exports fell by 16.7% to just under 22.0 Mt with the pellet market registering a drop of 13.5% in exports while the concentrate market fared even worse with a drop of 24.1%. The drastic fall in demand for concentrate in 2001 mirrored that of the previous year when the hike in the price for gas, used for pelletization, was compounded by the economic slowdown.

- Following its acquisition in August 2000 of North Ltd. of Australia and the latter's 56.1% controlling interest in **IOC**, Rio Tinto Ltd. acquired a 20% share of the 18.9% stake in IOC owned by the Labrador Iron Ore Royalty Income Fund. Mitsubishi Corp. owns the remaining 25% stake in IOC. Since acquiring IOC, Rio Tinto has been active in upgrading the Quebec and Labrador installations as well as its load and haul fleet. It also initiated a tailings management program to comply with the new federal Metal Mining Effluent Regulations (MMER). Under this program IOC will build a dyke to confine its tailings in Wabush Lake and to comply with a suspended solids effluent criterion of 15 mg/L. The first phase of that project is scheduled for completion by 2006. Moreover, on September 27, 2001, in response to deteriorating market conditions, Rio Tinto announced it was postponing the refurbishment and reactivation of its pellet plant in Sept-Îles, Quebec. Commissioning of the $361.5 million project, scheduled for June 2002, would have resulted in the addition of 4.5 Mt of capacity to the company's pellet production.

- On the eve of reaching in 2002 its 45th year of incorporation and 500 Mt of iron ore concentrate production, the co-owners (50:50) of **QCM**, **CAEMI Mineração e Metalurgia S.A.** and **Dofasco Inc**., announced their intent to sell their share of the company. CAEMI is being forced to sell its shares by the European Union Commission in response to the takeover of CAEMI by CVRD and Mitsui. Dofasco announced its intent to evaluate strategic options related to its QCM investment. Affected by declining markets, QCM shut down its Mount Wright operation for 14 weeks during the year (including a lockout from March 19 to April 30) and laid off part of its work

Figure 1
Iron Ore in Canada, 2001



Numbers refer to locations on map above.

PRODUCERS

1. Iron Ore Company of Canada, Carol Lake Division (mine/concentrator/pellet plant)
2. Wabush Mines (mine/concentrator)
3. Quebec Cartier Mining Company (mine/concentrator)
4. Iron Ore Company of Canada (port)
5. Wabush Mines (pellet plant/port)
6. Quebec Cartier Mining Company (pellet plant/port)

force. The pellet plant, for its part, was only closed during the lockout.

- A change in the marketplace forced **Wabush Mines** to scale down its production during the year from 6.2 Mt to 4.5 Mt. This was achieved by idling its facilities for a seven-week period and closing one of its three production lines in December. Meanwhile, the company proceeded with an important capital investment to address an ongoing operating concern regarding excess water in the pit due to the increasing depth of the operations. To date, the results have proven to be very positive.

INTERNATIONAL DEVELOPMENTS

According to the UNCTAD Trust Fund Project for Iron Ore Information, following an upsurge in 2000, world iron ore production decreased by 3.1% in 2001 to reach 931.2 Mt,[1] still the second highest production level ever reached by the industry. The countries registering the highest incremental increases were Peru (15.9%), Venezuela (9.2%), India (4.3%), South Africa (3.1%) and Australia (2.4%), while the countries registering the highest incremental decreases were the United States (27.4%), Canada (22.3%), Mauritania (10.0%) and Mexico (9.4%).

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[1] This figure includes the application of a conversion factor to China's low-grade natural iron ore production so that the latter's % Fe content is about equal, on average, to that in the rest of the world.

Similarly, world exports decreased 2.6% to 477.1 Mt in 2001. Australia maintained its position as the world's number one iron ore exporting country with exports totalling 164.4 Mt in 2001, closely followed, as usual, by Brazil with 155.7 Mt. Countries that improved their track record the most were India (13.3%) and the Republic of South Africa (9.8%), while those that registered the worst decreases were Canada (17.0%), Sweden (16.0%), Mauritania (9.0%) and the former Soviet Union (8.3%).

Variations observed in the import market are less important than in the export market. Total imports reached 477.9 Mt in 2001, a 1.9% decrease from the previous year. The most important retrenchments in 2001 (in quantities) were the European Union with 13.1% whereas, on an incremental basis, the United States registered the largest drop (at 31.8%), illustrating the slowdown of these economies. Japan remains the world's largest importer of iron ore (126.3 Mt), followed by China (92.3 Mt), South Korea (46.5 Mt) and Germany (40.1 Mt). However, China (with an increase of 31.9% in 2001 over the previous year) and South Korea (19.2%) – two countries involved in large infrastructure development programs – appear to be the leading forces of the growth in Asia while the economies of other Asian countries appear to be fragile.

PRICES

On the strength of the world steel industry at the beginning of 2000, during the period when prices are negotiated on the European and Japanese markets, and despite reduced production in North America, iron ore producers were able to negotiate reasonable price increases for the year. Prices jumped respectively by 4.55% and 4.29% for concentrate bound for Europe and Japan and by 1.84% for pellets bound for Europe. However, despite these price increases, the value of Canada's exports fell by 10.7% to about $943 million.

OUTLOOK

The consolidation and restructuring of the global iron ore industry witnessed in the past two years should continue during the coming years to enable producers to improve their competitiveness through economies of scale. This will help the iron ore and steel industry preserve its market share as a supplier of low-cost, versatile, high-performance material of choice for use in a variety of applications.

Any change in the economic situation in Asia is expected to have a marked impact on steel markets and, consequently, on iron ore use. China, one of the fastest growing economies in the world, is expected to continue to look to foreign suppliers to satisfy a large part of its iron ore requirements. Chinese imports of iron ore rose from 14.3 Mt in 1990 to over 92 Mt in 2001, representing an annual growth rate of over 18%. The development of a more modern market economy in China and the demand for higher-quality products are expected to lead that country to maintain or increase its present level of imports.

The stabilization of Canadian iron ore shipments in the last quarter of 2001, on a year-to-year basis, tends to indicate the industry reached its low point and that a recovery will start to take place in the first half of 2002. However, according to various indicators, this recovery will not be vigorous and may result in Canadian shipments of iron ore reaching a level of around 32 Mt in 2002. On that account, Wabush Mines expects to produce at about 75% of its capacity in 2002 while QCM is planning a production level in the order of 12-13 Mt. IOC plans to review the situation in early 2002 before it decides whether or not it will maintain its 2001 production level.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 1, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. CANADA, IRON ORE PRODUCTION AND TRADE, 2000 AND 2001

Item No.		2000		2001 (p)	
		(tonnes) (1)	($000)	(tonnes) (1)	($000)
PRODUCTION (mine shipments)					
	By province				
	Newfoundland and Labrador	21 091 517	902 134	17 306 892	768 288
	Quebec	14 057 035	x	9 600 000	x
	British Columbia	98 340	x	74 246	x
	Total (2)	35 246 892	1 424 448	26 981 138	1 155 187
IMPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	United States	55 738	1 410	91 194	2 196
	Lebanon	–	–	84	4
	Russia	–	–	46	2
	Mongolia	–	–	73	2
	Greenland	–	–	39	2
	Germany	141	4	29	1
	Australia	–	–	18	1
	France	60	2	35	1
	China	14	1	35	1
	Ukraine	–	–	2	. . .
	Morocco	–	–	4	. . .
	Liberia	–	–	2	. . .
	Iran	–	–	3	. . .
	Peru	–	–	3	. . .
	Belgium	–	–	1	. . .
	Indonesia	2	. . .	2	. . .
	Brazil	–	–	7	. . .
	Canada	155	5	10	. . .
	India	2	. . .	8	. . .
	Gabon	1	. . .	–	–
	Guinea	2	. . .	–	–
	Hong Kong	2	. . .	–	–
	Turkey	8	. . .	–	–
	Japan	9	. . .	–	–
	Spain	3	. . .	–	–
	United Kingdom	15 440	386	–	–
	Mexico	103	4	–	–
	Tanzania	4	. . .	–	–
	South Africa	34	1	–	–
	Uganda	1	. . .	–	–
	Total	71 719	1 813	91 595	2 210
2601.12	Iron ore, and concentrates, agglomerated				
	United States	6 344 821	347 946	5 814 337	332 368
	Sweden	–	–	2	. . .
	Brazil	86 693	6 654	–	–
	Venezuela	62 726	3 255	–	–
	United Kingdom	71	4	–	–
	Taiwan	24	1	–	–
	Total	6 494 335	357 860	5 814 339	332 368
EXPORTS					
2601.11	Iron ore concentrates, non-agglomerated				
	Germany	2 539 276	68 301	1 697 483	47 215
	United Kingdom	1 711 708	40 913	1 124 106	29 838
	Netherlands	691 443	19 535	830 757	24 200
	Japan	685 376	17 902	822 119	21 802
	South Korea	372 999	9 215	482 153	13 807
	France	1 106 050	26 008	535 186	11 387
	United States	485 902	14 236	339 143	10 602
	China	235 197	6 401	164 980	4 666
	Philippines	168 293	4 499	57 979	986
	Austria	–	–	15 703	443
	Total	7 996 244	207 010	6 069 609	164 946

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes) (1)	($000)	(tonnes) (1)	($000)
EXPORTS (cont'd)					
2601.12	Iron ore and concentrates, agglomerated				
	United States	7 504 883	340 019	4 187 959	195 991
	Germany	2 618 565	124 951	3 245 483	157 796
	Italy	2 149 678	102 031	1 691 891	83 015
	Trinidad and Tobago	–	–	1 169 587	68 981
	United Kingdom	1 665 538	76 717	1 213 452	57 934
	Netherlands	1 053 277	51 595	955 690	48 791
	Australia	736 003	35 340	952 449	44 553
	Taiwan	248 963	10 820	659 138	31 411
	China	448 015	21 567	427 394	21 453
	Belgium	563 296	26 889	308 148	14 709
	Turkey	299 030	11 326	292 342	14 433
	France	464 548	21 159	251 732	12 625
	Malaysia	99 985	4 147	148 571	7 912
	Egypt	–	–	136 055	6 495
	Japan	149 135	7 204	80 871	3 988
	Switzerland	–	–	59 801	2 855
	Philippines	164 591	4 510	85 145	2 725
	South Korea	75 001	3 701	45 897	2 289
	Portugal	151 622	7 241	–	–
	Total	18 392 130	849 217	15 911 605	777 956
	Total exports, all classes				
	Germany	5 157 841	193 252	4 942 966	205 011
	United States	7 990 785	354 255	4 527 102	206 593
	United Kingdom	3 377 246	117 630	2 337 558	87 772
	Netherlands	1 744 720	71 130	1 786 447	72 991
	Italy	2 149 678	102 031	1 691 891	83 015
	Trinidad and Tobago	–	–	1 169 587	68 981
	Australia	736 003	35 340	968 152	44 996
	Taiwan	248 963	10 820	659 138	31 411
	China	683 212	27 968	592 374	26 119
	Japan	834 511	25 106	902 990	25 790
	France	1 570 598	47 167	786 918	24 012
	South Korea	448 000	12 916	528 050	16 096
	Belgium	563 296	26 889	308 148	14 709
	Turkey	299 030	11 326	292 342	14 433
	Malaysia	99 985	4 147	148 571	7 912
	Egypt	–	–	136 055	6 495
	Philippines	332 884	9 009	143 124	3 711
	Switzerland	–	–	59 801	2 855
	Portugal	151 622	7 241	–	–
	Total	26 388 374	1 056 227	21 981 214	942 902

Sources: Natural Resources Canada; Statistics Canada; American Iron Ore Institute.

– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.

(1) Dry tonnes for production (shipments) by province or territory; natural weight for imports and exports. (2) Total iron ore shipments include shipments of by-product iron ore.

TABLE 2. CANADA, IRON ORE SHIPMENTS, 1996-2001

Company and Location	Ore Mined	Product Shipped	1996	1997	1998	1999	2000	2001 (p)
			(000 tonnes, natural or wet)					
Algoma Ore Division Algoma Steel Inc. Wawa, Ontario	Siderite	Sinter (1)	733	795	651	–	–	–
Iron Ore Company of Canada Schefferville, Quebec	Hematite, goethite and limonite	Direct shipping	–	–	–	–	–	–
Carol Lake, Newfoundland and Labrador	Specular hematite and magnetite	Concentrate	4 038	4 678	5 172	3 983	3 955	3 415
		Acid pellets	2 430	. .	. .	2 408	. .	. .
		Fluxed pellets	8 075	11 372	12 248	3 190	11 466	9 908
		Limestone pellets	. .	. .	. .	3 870	. .	. .
		Direct reduced pellets	. .	. .	. .	211	. .	. .
		Chips	169	. .	. .	. .	. .	. .
Loadstone Limited Newfoundland and Labrador	Magnetite	Concentrate	300	100	–	–	–	–
Quebec Cartier Mining Company Mount Wright, Quebec	Specular hematite	Concentrate	7 264	7 159	(r) 6 757	6 304	6 163	3 500
		Acid pellets	2 521	3 795	(r) 3 577	2 820	. .	2 200
		Self-fluxed pellets	5 481	4 324	(r) 2 824	3 036	8 234	2 000
		Low-Si pellets	51	225	(r) 1 638	1 591	. .	1 100
		Low-Si self-fluxed pellets	–	–	103	1 045	. .	1 000
Wabush Mines Wabush, Labrador and Pointe-Noire, Quebec	Specular hematite and magnetite	Acid pellets	3 155	(r) 3 440	(r) 3 127	(r) 3 223	(r) 5 983	2 945
		Fluxed pellets	2 158	(r) 2 257	(r) 2 518	(r) 2 009	. .	1 499
		Concentrate	–	. .	. .	(r) 35	. .	. .
		Chips	24	. .	. .	. .	. .	110
British Columbia producers	Magnetite	Concentrate	88	100	102	(r) 92	102	81
Total			36 486	38 245	38 717	(r) 33 790	(r) 35 903	27 758

Source: Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary; (r) Revised.
(1) Includes about 400 000 t of iron-bearing material not from the mine.

TABLE 3. RECEIPTS, USE AND INVENTORIES OF IRON ORE AT CANADIAN IRON AND STEEL PLANTS, 2000 AND 2001

	2000	2001
	(000 tonnes)	
Receipts imported	6 850	5 974
Receipts from domestic sources	6 468	6 444
Total receipts at iron and steel plants	13 318	12 418
Use of iron ore	14 042	12 381
Inventory at docks, plants, mines and furnace yards, December 31	8 818	10 420
Inventory change	465	1 602

Source: American Iron Ore Association.

TABLE 4. WORLD IRON ORE PRODUCTION, 1999-2001

	1999	2000	2001
		(000 tonnes, natural)	
China	92 200	96 100	102 000
Brazil	188 700	200 400	208 700
Australia	162 700	176 300	180 500
Russia	81 900	87 000	82 500
India	70 200	75 000	79 200
United States	57 800	63 000	45 800
Ukraine	47 100	55 000	54 700
Canada	34 000	35 900	27 900
South Africa	29 500	33 700	34 800
Sweden	18 900	20 600	19 500
Venezuela	17 000	17 400	19 000
Mauritania	10 400	11 500	10 300
Kazakhstan	9 100	15 000	14 100
Other countries	48 900	50 900	52 400
Total	868 400	937 800	931 400

Sources: Natural Resources Canada; Interfax; UNCTAD Trust Fund Project on Iron Ore Information.

TABLE 5. SELECTED PRICES OF IRON ORE BOUND FOR JAPAN AND EUROPE, 1987-2001

Ore	Market	Source	1987	1989	1991	1993	1995	1997	1999	2000	2001
						(US¢/Fe Unit Dmt, f.o.b.)					
Fines (including concentrate)	Europe	CVRD	24.50	26.56	33.25	29.09	28.38	30.15	27.59	28.79	30.03
		Iscor	. .	20.70	. .	22.61	21.79	23.35	(r) 21.37	22.30	23.26
		Kiruna	25.25	30.00	37.1	30.50	30.85	32.70	29.55	31.83	33.30
		Carol Lake	24.03	27.00	34.6	28.50	27.70	30.00	27.20	28.60	29.90
		Mt. Wright	24.03	27.00	34.6	28.50	27.70	30.00	27.20	28.60	29.90
	Japan	CVRD	21.89	23.61	30.05	25.02	24.45	26.16	23.99	25.01	26.06
		Iscor	18.85	20.37	25.09	21.23	20.32	21.78	19.93	20.80	21.69
		Hamersley (2)	24.28	26.34	32.96	27.90	26.72	28.64	26.21	27.35	28.52
		Carol Lake	20.93	22.52	28.18	24.26	23.23	24.90	22.79	23.78	24.80
Lump	Europe	Iscor	23.50	. .	34.72	29.38	30.39	32.13	(r) 29.70	31.41	32.42
		Hamersley (1)	33.15	43.00	50.25	42.06	45.15	45.91	40.75	45.56	47.21
	Japan	CVRD	21.89	25.20	30.96	25.91	26.31	27.63	25.54	27.02	27.89
		Iscor	21.99	26.05	31.51	27.17	28.29	30.02	27.76	29.36	30.31
		Hamersley (2)	28.33	33.23	40.83	34.78	35.32	37.09	34.28	36.26	37.43
Pellets	Europe	CVRD	36.70	47.33	52.15	43.64	49.14	52.10	46.46	49.24	50.10
		Kiruna	41.15	53.50	57.50	45.70	52.40	55.10	48.70	53.00	54.08
		Carol Lake	37.15	48.35	53.00	44.25	50.05	53.25	47.15	50.60	51.53
		Mt. Wright	37.15	48.35	53.00	44.25	50.05	53.25	47.15	50.60	51.53
	Japan	CVRD	35.04	44.49	49.03	41.03	46.19	48.98	43.68	46.29	47.10
		Savage River	34.17	42.10	46.39	38.83	43.72	46.35	41.33	43.80	44.57

Sources: *The Tex Report; Skillings Mining Review*; UNCTAD.

. . Not available; Dmt Dry metric tonne; f.o.b. Free on board; (r) Revised.

(1) c.i.f. Rotterdam; (2) f.o.b. Dampier.

Note: Price is reported in cents, U.S. currency, for each percentage point of iron in a tonne of ore, e.g., at 30¢/Fe unit, ore grading 65% iron would bear a price of 65 x 30¢ = US$19.50/t.

Lead

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According to preliminary figures from the International Lead and Zinc Study Group (ILZSG), world lead usage fell slightly in 2001 to 6.4 Mt, down 1.2% from the record high 6.5 Mt in 2000. World mine production of lead rose by 1% to just over 3 Mt while lead metal production dropped slightly to 6.5 Mt. Overall, there was a close balance between total supply and demand in the Western World with the shortfall made up from imports from former Eastern countries. Lead inventories held in London Metal Exchange (LME) warehouses fell by 33 000 t in 2001; however, stocks reported by producers were 36 000 t higher than at the end of 2000.

CANADIAN DEVELOPMENTS

2001 mine production:	$95.8 million
World rank:	Seventh (metal production)
Exports:	$286 million

Canada	1999	2000	2001
	(000 tonnes)		
Mine production	162	149	154
Metal production	266	284	231
Usage	70	68	55

Canada ranked fifth in terms of the mine production of lead after Australia, China, the United States and Peru, and seventh in terms of metal production in 2001 (Figure 4). Significant events in Canada in 2001 included the closure of the Sullivan mine in December and the announcements of closures in 2002 of the Nanisivik and Polaris mines in Nunavut. Together the closure of these three mines will leave the Brunswick mine in New Brunswick as the sole major producer of lead concentrates in Canada.

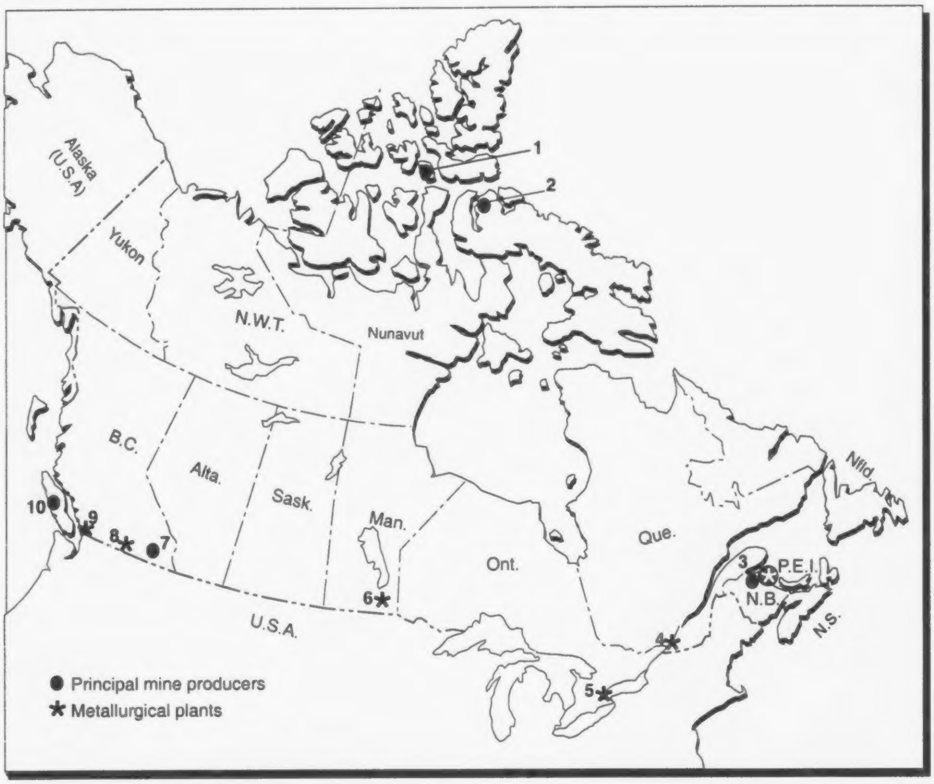
- In terms of corporate events, Teck Corporation and Cominco Ltd. merged to create Teck Cominco Limited in July. Headquartered in Vancouver, it ranks as the fourth largest North American-based base-metals mining and refining company. In November, Boliden Limited shareholders approved the return of the company's headquarters from Toronto back to Stockholm, Sweden. Boliden moved to Toronto from Sweden in 1997.

- Cominco Ltd. began a series of announced production cutbacks at its Trail smelter complex in southern British Columbia in December 2000. The cutbacks at Trail were part of a plan to allow for a fixed price power swap agreement with a major U.S. energy company. All production at the lead smelter stopped in September to examine health concerns related to workers exposed to thallium while performing furnace maintenance. Production resumed in November.

- On Friday, December 21, the Sullivan mine was closed after 92 years of active production. The mine produced more than $20 billion in lead, zinc and silver over its life and provided employment for more than four generations of miners in the Kimberley region. Teck Cominco started an extensive decommissioning and reclamation process at the site.

- Exide Technologies announced that it was going to delay the production start-up of industrial-type lead-acid batteries at its Maple, Ontario, plant until at least the first quarter of 2002.

Figure 1
Lead Producers in Canada, 2001

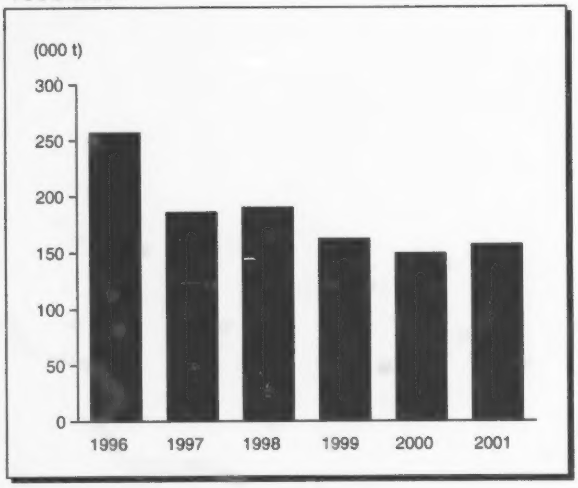

Alaska (U.S.A)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
4
5
6
7
8
9
10
● Principal mine producers
* Metallurgical plants

Numbers refer to locations on map above.

LEAD-PRODUCING MINES	WEB SITE
1. Polaris, Teck Cominco Limited	www.teckcominco.com
2. Nanisivik, Breakwater Resources Ltd.	www.breakwater.ca
3. Brunswick, Noranda Inc.	www.noranda.com
7. Sullivan, Teck Cominco Limited (closed Dec. 2001)	www.teckcominco.com
10. Myra Falls, Boliden Limited	www.boliden.ca

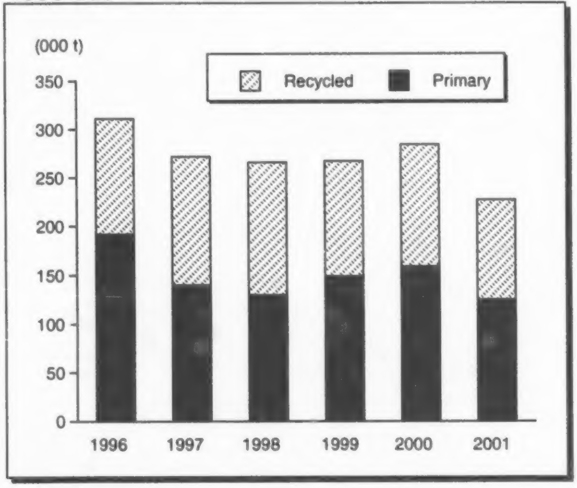
LEAD METALLURGICAL PLANTS	
3. Belledune, Noranda Inc.	www.noranda.com
4. Nova Pb Inc. General Smelting Company of Canada American Iron and Metal Co. (1999) Inc.	www.novapb.com www.americanironandmetal.com
5. Tonolli, Tonolli Canada Ltd. and Canada Metal Company	
6. The Canada Metal (Western) Ltd.	
8. Trail, Teck Cominco Limited	www.teckcominco.com
9. Metalex Products Ltd.	

Figure 2
Canadian Mine Production of Lead, 1996-2001



Source: Natural Resources Canada.

Figure 3
Canadian Refined Lead Metal Production, 1996-2001



Source: Natural Resources Canada.

WORLD DEVELOPMENTS

World	1999	2000	2001
	(000 tonnes)		
Mine production	2 978	2 973	3 003
Metal production	6 280	6 593	6 510
Usage	6 231	6 497	6 418

According to ILZSG data, world mine production of lead increased slightly to just over 3 Mt in 2001, up from 2.9 Mt in 2000 (Figure 4). A 10% rise in mine production in Australia was mainly due to increased output at the Century and Pillara mines. Chinese production of lead rose by 7% in 2001. Asian output was also up, based on a 15.4% rise in production in Kazakhstan.

World lead metal production fell by 1.3% to 6.5 Mt in 2001 (Figure 5). Output in the United States fell by 6.6% in 2001, mainly as a consequence of cutbacks at the Herculaneum smelter. In Europe, cutbacks in Belgium, France, Germany and Italy were partially offset by an increase in the United Kingdom, resulting in a slight fall in European production of less than 1% in 2001. Increases in China offset losses in Japan, South Korea and Kazakhstan, leading to a 4% rise in lead metal production in Asia in 2001. A record 61.6% of Western World refined lead metal output was produced using recycled materials in 2001, mainly in the form of used lead-acid batteries.

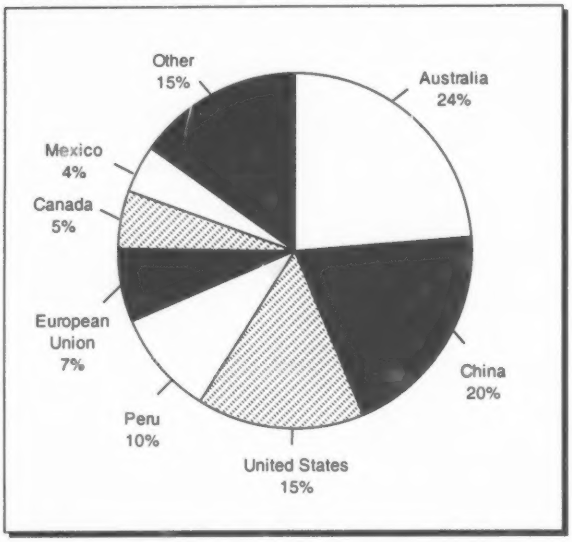
- In March 2001, The Doe Run Company reduced its lead output by 80 000 t/y by closing two mines in the United States and cut its lead concentrates purchases. The company placed its No. 29 mine in its southeast Missouri Mining Division on care and maintenance. The No. 28 mine at the division will be mined to closure this year. As a result of the closures, production at Doe Run's Herculaneum smelter will fall from 250 000 t/y to 170 000 t/y.

- Grupo Mexico S.A. de C.V. announced in May that its wholly owned subsidiary, Asarco Inc., would continue the suspension of operations at its 70 000-t/y East Helena lead smelter in the United States until market conditions and the supply of lead concentrates and other raw materials improved.

- Weak zinc prices and the strength of the Mexican peso led Dowa Mining Co., Ltd. to temporarily suspend production at the Minera Rey de Plata lead-zinc mine in Guerrero State in December. Minera Rey de Plata is owned 51% by Mexico's Mina Peñoles SA, 39% by Dowa Mining, and 10% by Sumitomo Corp.; it began operations in 1997.

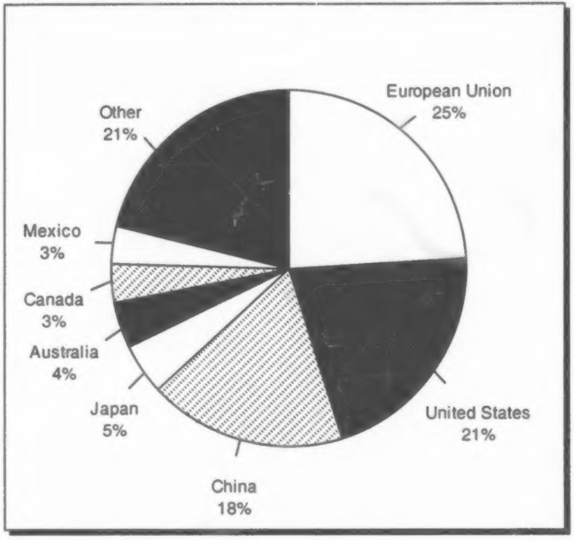
- Boliden Limited closed the Laisvall mine located in Norrbotten, Sweden, in October after nearly 60 years of production. Elsewhere in Europe, the company's subsidiary, Boliden Apirsa SL, ceased production at its Los Frailes operations in Spain.

Figure 4
World Lead Mine Production, 2001



Source: International Lead and Zinc Study Group.

Figure 5
World Refined Lead Metal Production, 2001



Source: International Lead and Zinc Study Group.

- Exide Technologies, the U.S.-based battery maker and lead recycler, announced plans to close two automotive battery manufacturing plants in North America and to restructure its European operations.
- The Yuguang Gold and Lead Group completed an expansion project in China that added 50 000 t/y of capacity, increasing the company's total lead production capacity to 130 000 t/y.
- Pasminco Limited was placed into voluntary administration in September in an attempt to restructure the company's debt of over A$3.4 billion. As part of the restructuring, the new Century lead-zinc mine in Queensland was put up for sale. By year-end, however, the administrator had applied for and received permission from the Australian Federal Court to reschedule the next meeting of creditors from January 7, 2002, to April 7, 2002.

LEAD USE

Preliminary statistics from the ILZSG indicate that total world lead demand fell slightly to just over 6.4 Mt in 2001. Western World demand declined 3% to 5.4 Mt. European Union member states and the United States accounted for more than half of world lead demand while China accounted for another 10% (Figure 6).

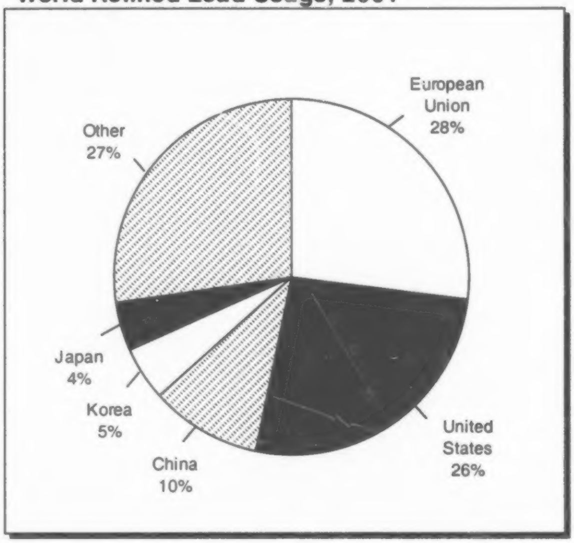
Lead-acid batteries constitute the largest market for lead, representing about 75% of total Western World usage. The largest market for batteries, representing about 80% of lead used in the industry, is the automotive sector. The average automobile battery contains about 10 kg of lead. Some factors that influence lead demand in the automotive sector are new vehicle production, trends and age in vehicle population, and climatic conditions. For example, hotter summers and colder winters in North America and Europe during the last few years have contributed to a greater number of battery failures and increased replacement battery demand (Figure 7).

The second largest use of lead is in pigments and compounds, which accounted for 8.8% of Western World demand in 2000. The principal uses are in PVC stabilizers, which prevent degradation during processing or from ultraviolet radiation; in colour pigments; and in the manufacture of glass, including crystal, light bulbs, insulators and television/computer screens. While lead is still used for some specific paint applications, its general use in this application has declined significantly due to the potential risk involved in exposure to weathered or flaked paint.

INTERNATIONAL ORGANIZATIONS

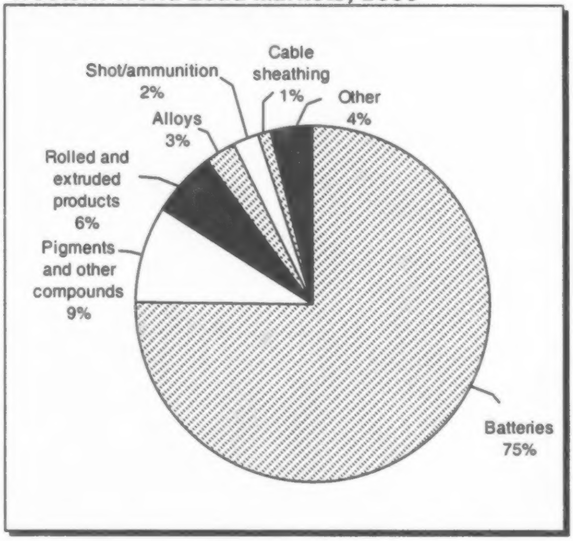
The International Lead and Zinc Study Group was formed in 1959 to improve market information and provide opportunities for regular intergovernmental consultations on issues related to lead and zinc mar-

Figure 6
World Refined Lead Usage, 2001



Source: International Lead and Zinc Study Group.

Figure 7
Western World Lead Markets, 2000



Source: International Lead and Zinc Study Group.

kets. Particular attention is given to providing regular and frequent information on the supply, demand and outlook for lead and zinc.

The Study Group is headquartered in London, England. In 2000, 28 countries, representing most of the world's major lead- and zinc-producing and using nations, were members of the Group. The Group has an extensive information-gathering and dissemination role and acts as an effective mechanism for increasing market transparency related to the production, usage and trade of lead and zinc. The Group is also an important forum for communication among governments, among industry, and between governments and industry. It holds a general session each year in October. Member countries' delegations include industry representatives as advisors. Canada has been an active member of the Group since its inception.

The 46th Session of the Study Group was held in New Delhi, India, in October 2001 and was attended by some 85 registered participants, including representatives of 23 member countries and observers from several invited nations, industry and non-governmental organizations. As part of the work of the Group's Economic and Environment Committee, two new reports will be published in 2002: *The Use of Zinc in Construction and Public Infrastructure* and *The Use of Lead and Zinc in Chemicals*. Work is also continuing on a joint Study Group workshop on recycling to be held sometime in 2003.

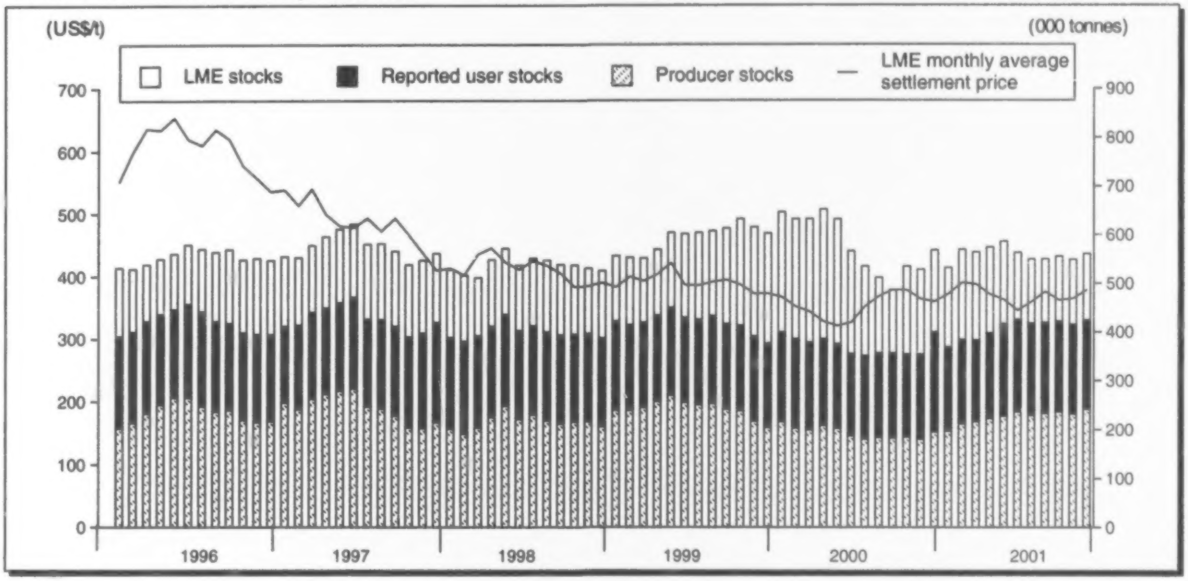
The Group continues to work on updating its capacity to deliver, through electronic means, its monthly lead and zinc statistical bulletin. The monthly bulletin is now available to member countries and subscribers on-line through the Group's web site. The development of an interactive version of the bulletin and other improvements to the site continue. The Study Group will hold its next Annual Session and meetings of its Committees and Industry Advisory Panel in Stockholm, Sweden, from October 4 to 6, 2002.

More information about the Group's activities and the availability of a wide range of publications pertaining to lead and zinc can be obtained from its web site at www.ilzsg.org. For information on the Group's activities in partnership with the International Copper Study Group and the International Nickel Study Group related to the contribution nonferrous metals make to sustainable development and the Non-Ferrous Metals Consultative Forum, visit their joint web site at www.nfmsd.org.

PRICES AND STOCKS

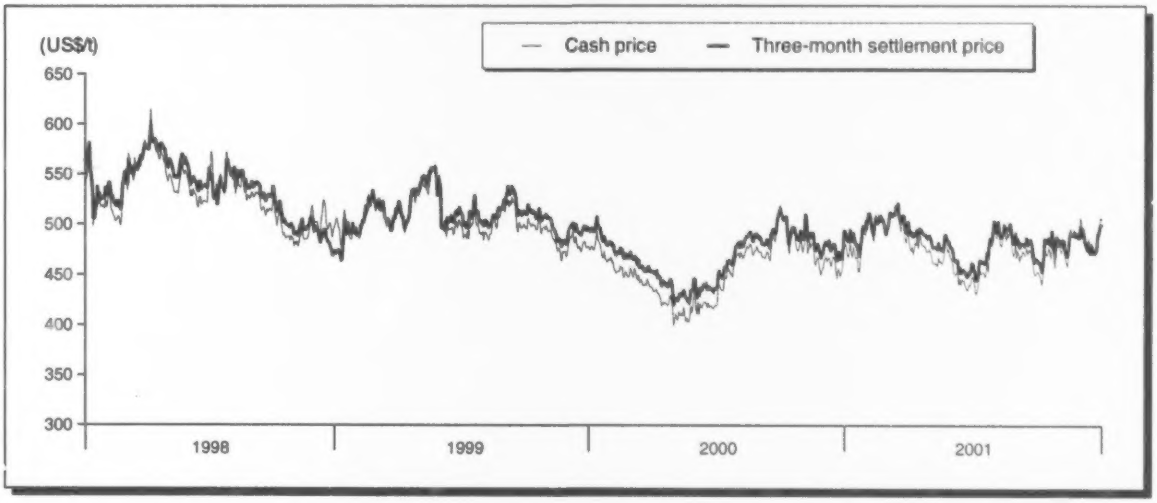
Cash settlement and forward three-month prices on the London Metal Exchange (LME) in 2001 averaged US$476/t and US$483/t, respectively, 4.8% and 3.2% higher than in 2000. Prices during the year peaked at US$523/t in March and reached their lowest level of US$431/t in July (Figure 9).

Figure 8
Lead Prices and Stocks, 1996-2001



Source: International Lead and Zinc Study Group.

Figure 9
LME Daily Official Cash and Three-Month Settlement Prices, 1998-2001



Source: London Metal Exchange.

Inventories held in LME warehouses fell by 33 000 t in 2001 to 97 700 t at year-end. However, stocks reported by producers were 46 000 t higher than at the end of 2000, reaching a total of 198 000 t (Figure 8).

OUTLOOK

According to the International Lead and Zinc Study Group, a forecast rise in lead demand in Asia of 2.7% is expected to be balanced by a 4.3% decline in the United States, resulting in an overall similar level of global demand for refined lead metal in 2002 compared to 2001. In the West, however, demand is forecast to fall by just over 1%. Reductions in lead mine output in the United States and mine closures in Canada, Spain and Sweden are expected to result in an overall decrease in mine output of 7.2% globally and 9.7% in the West. In Canada, mine production is expected to decline by about 37% in 2002 to 85 000 t with the closure of the Sullivan mine at the end of 2001 and the Polaris and Nanisivik mines at the end of the first half of 2002.

Decreases in refined lead metal output in Europe, China and the United States are expected to be offset by rises in Australia, Canada, South Korea, Malaysia and Morocco. Overall, the production of refined lead metal in 2002 is expected to be 0.8% lower globally than in 2001 and 0.5% higher in the Western World. The level of net exports of refined lead from China to the West is expected to be constrained by the restricted availability of suitable raw materials.

Taking all available factors into consideration, the Study Group's latest forecast indicates that there will be a close balance between the supply and demand for refined lead in the Western World in 2002. Over the long term, lead demand is expected to maintain an average annual growth rate of 1.5-2.0%. The battery sector will continue to account for most of the growth, with the newly industrialized nations of Southeast Asia expected to continue to record their most rapid growth as their vehicle population expands.

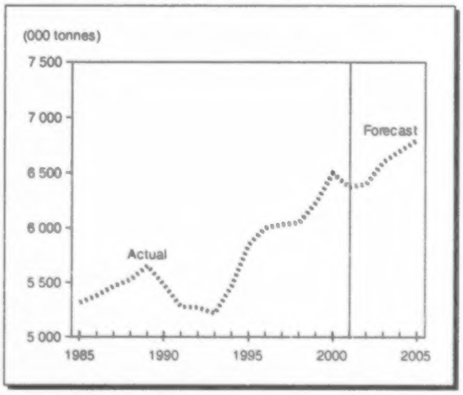
Prices are expected to average slightly higher than last year at about US$490/t. In the longer term, prices are expected to average between US$500 and $550/t to the year 2005.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 5, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

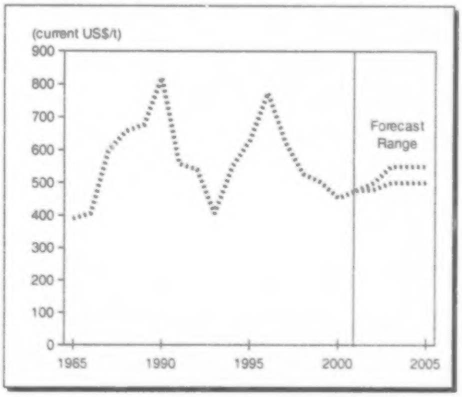
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 10
World Lead Usage, 1985-2005



Source: Natural Resources Canada.

Figure 11
LME Cash Settlement Lead Prices, 1985-2005



Source: Natural Resources Canada.

TARIFFS

		Canada			United States	EU	Japan (1)
Item No.	Description	MFN	GPT	USA	Canada (1)	MFN	WTO
2607.00	Lead ores and concentrates	Free	Free	Free	Free	Free	Free
78.01	Unwrought lead						
7801.10	Refined lead						
7801.10.10	Pig and block	Free	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.10.90	Other	2.5%	Free	Free	Free	2.5%	Free-2.70 yen/kg
7801.91	Other: Containing by weight antimony as the principal other element	Free	Free	Free	Free	2.5%	Free to 2.8%
7801.99.10	Lead bullion	2.5%	Free	Free	Free	Free	3%
7801.99.20	Lead alloys	2.5%	Free	Free	Free	2.5%	Free to 2.8%
7801.99.90	Other	2.5%	Free	Free	Free	2.5%	Free-2.70 yen/kg
7802.00	Lead waste and scrap	Free	Free	Free	Free	Free	2.1%
7803.00	Lead bars, rods, profiles and wire						
7803.00.10	Bars and rods, not alloyed	2.5%	Free	Free	Free	5%	3%
7803.00.90	Unwrought lead, other	3%	Free	Free	Free	5%	3%
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) not exceeding 0.2 mm						
7804.11.10	Of lead-tin alloys, whether or not containing antimony	Free	Free	Free	Free	5%	3%
7804.11.90	Other	3%	Free	Free	Free	5%	3%
7804.19	Lead plates, sheet, strip and foil, n.e.s.						
7804.19.10	Not alloyed, of a thickness exceeding 0.2 mm but not exceeding 5 mm, and a width exceeding 600 mm	2.5%	Free	Free	Free	5%	3%
7804.19.20	Of lead-antimony-tin alloys	2.5%	Free	Free	Free	5%	3%
7804.19.90	Other	2.5%	Free	Free	Free	5%	3%
7804.20	Powders and flakes						
7804.20.10	Powders, not alloyed	2.5%	Free	Free	Free	Free	3%
7804.20.20	Alloyed powders; flakes	2.5%	Free	Free	Free	Free	3%
7805.00	Lead tubes, pipes, and tube or pipe fittings	3%	Free	Free	Free	5%	3%
7806.00	Other articles of lead	3%	Free	Free	Free	Free to 5%	3%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (41st Annual Edition: 2001); *Customs Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).

(1) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, LEAD PRODUCTION AND TRADE, 2000 AND 2001, AND USE, 1999 AND 2000

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS (1)					
	New Brunswick	64 490	43 466	79 998	57 999
	British Columbia	46 930	31 631	36 688	26 599
	Nunavut	31 883	21 489	32 743	23 738
	Total	143 303	96 586	149 429	108 336
	Mine output (2)	148 769	. .	157 127	. .
	Refined production				
	Primary	159 192	. .	125 185	. .
	Recycled	125 141	. .	101 637	. .
	Total	284 333	. .	226 822	. .
EXPORTS					
2603.00.20	Lead content of copper ores and concentrates	1 000	269	–	–
2607.00	Lead ores and concentrates				
	Sweden	23 786	17 224	23 384	16 597
	Germany	10 196	7 480	10 600	7 860
	China	3 691	1 141	15 049	7 575
	Belgium	–	–	4 792	2 454
	Italy	–	–	4 368	2 320
	Total	37 673	25 845	58 193	36 806
2607.00.20	Lead content of lead ores and concentrates	37 673	25 845	58 163	32 809
2608.00.20	Lead content of zinc ores and concentrates	12 227	3 761	10 929	3 458
2616.10.20	Lead content of silver ores and concentrates	–	–	–	–
7801.10	Unwrought lead				
	Refined lead				
	United States	146 223	122 216	123 586	104 485
	Italy	–	–	1 604	1 120
	Japan	199	266	116	166
	Malaysia	–	–	71	61
	Other countries	722	503	–	–
	Total	147 144	122 985	125 377	105 832
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	19 717	18 901	18 225	18 234
7801.99	Lead, unwrought, n.e.s.	59 371	50 999	28 775	26 603
7802.00	Lead waste and scrap				
	United States	4 016	1 320	1 632	729
	Other countries	31	39	–	–
	Total	4 047	1 359	1 632	729
7803.00	Lead bars, rods, profiles and wire				
	United States	485	1 398	308	490
	Other countries	1	1	–	–
	Total	486	1 399	308	490
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	47	117	–	–

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7804.19	Lead plates, sheet, strip and foil, n.e.s.	745	1 156	877	1 199
7804.20	Lead powders and flakes	6	61	89	113
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	18	152	8	28
7806.00	Other articles of lead				
	United States	. .	4 752	. .	5 876
	Other countries	. .	21	. .	48
	Total	. .	4 773	. .	5 924
	Total exports	. .	257 622	. .	232 225
IMPORTS (3)					
2603.00.00.20	Lead content of copper ores and concentrates	. . .	. . .	–	–
2607.00	Lead ores and concentrates				
	United States	14 318	21 457	23 477	58 579
	Peru	26 786	43 103	28 374	39 120
	Chile	10	3 131	3 079	3 859
	Honduras	3 269	3 923	16	2 793
	Morocco	9	2 712	1 579	2 273
	Brazil	5	771	13	1 776
	Other countries	6 181	7 825	1 286	2 449
	Total	50 578	82 922	57 824	110 849
2607.00.00.20	Lead content of lead ores and concentrates	47 300	56 373	52 652	63 520
2608.00.00.20	Lead content of zinc ores and concentrates	380	529	2 376	2 153
2616.10.00.20	Lead content of silver ores and concentrates	4 359	2 113	3 186	1 767
7801.10.10	Unwrought lead Refined lead, pig and block	4 747	4 370	975	834
7801.10.90	Refined lead, other	179	206	2 349	6 762
7801.91	Lead, unwrought, containing by weight antimony as the principal other element	4 177	4 241	205	236
7801.99	Lead, unwrought, other	8 431	38 157	495	1 770
7802.00	Lead waste and scrap				
	United States	65 354	14 241	54 956	11 882
	Other countries	54	40	221	102
	Total	65 408	14 281	55 177	11 984
7803.00	Lead bars, rods, profiles and wire				
	United States	1 535	2 104	842	1 354
	Other countries	11	20	275	498
	Total	1 546	2 124	1 117	1 852
7804.11	Lead sheets, strip and foil of a thickness (excluding any backing) <0.2 mm	311	387	396	429
7804.19	Lead plates, sheet, strip and foil, n.e.s.	152	230	201	294
7804.20	Lead powders and flakes	93	169	71	136

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (3) (cont'd)					
7805.00	Lead tubes, pipes, and tube or pipe fittings (i.e., couplings, elbows, sleeves)	25	39	18	30
7806.00	Other articles of lead				
	United States	3 913	4 554	4 049	5 416
	Japan	512	660	371	467
	Netherlands	4	4	234	327
	France	56	32	166	173
	Germany	98	91	130	122
	Other countries	94	122	161	190
	Total	4 677	5 463	5 111	6 695
	Total imports	192 363	211 604	182 153	209 311

	1999			2000 (p)		
	Primary	**Recycled** (5)	**Total**	**Primary**	**Recycled** (5)	**Total**
QUANTITY USED (4)						
Lead used for or in the production of:						
Antimonial lead	x	x	x	x	x	x
Batteries and battery oxides	16 741	20 024	36 765	13 286	12 915	26 201
Chemical uses: white lead, red lead, litharge, tetraethyl lead, etc.	x	x	x	x	x	x
Copper alloys: brass, bronze, etc.	14	11	25	14	13	27
Lead alloys:						
Solders	462	910	1 373	273	1 184	1 457
Others (including babbitt, type metals, etc.)	x	x	x	x	x	x
Semi-finished products:						
Pipe, sheet, traps, bends, blocks for caulking, ammunition, etc.	2 914	241	3 155	2 428	195	2 624
Other lead products	2 375	844	3 219	2 014	1 809	3 823
Total, all categories	34 108	58 449	92 557	30 146	51 219	81 365

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.

(1) Production includes recoverable lead in ores and concentrates shipped valued at the Montréal Exchange average price for the year.

(2) Lead content of domestic ores and concentrates exported. (3) Imports from "other countries" may include re-imports from Canada.

(4) Available data, as reported by users. (5) Includes all remelt scrap lead used to make antimonial lead.

Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, LEAD PRODUCTION, TRADE AND USE, 1975, 1980 AND 1985-2001

	Production				Exports (1)			Imports	Quantity Used (3)
		Refined							
	All Forms (2)	Primary	Recycled	Total	In Ores and Concentrates	Refined	Total	Refined	
					(tonnes)				
1975	349 133	171 516	. .	171 516	211 909	110 882	322 791	(a) 1 962	89 192
1980	251 627	162 463	72 117	234 580	147 008	126 539	273 547	(a) 2 602	106 836
1985	268 291	173 220	66 791	240 011	93 657	113 993	207 650	(a) 5 675	104 447
1986	334 342	169 934	87 746	257 680	118 373	111 831	230 204	(a) 4 247	94 680
1987	373 215	139 475	91 186	230 661	207 936	100 204	308 140	(a) 12 558	97 281
1988	351 148	179 461	88 615	268 076	200 822	179 946	380 768	15 132	88 728
1989	268 887	157 330	85 515	242 845	170 582	121 444	292 026	11 734	88 408
1990	233 372	87 180	96 465	183 645	221 566	84 007	305 573	11 781	72 203
1991	248 102	106 420	105 946	212 366	175 150	86 631	261 781	7 553	80 253
1992	339 626	151 252	101 633	252 885	190 822	131 546	322 368	8 289	92 420
1993	183 105	147 907	69 107	217 014	96 428	124 610	221 038	11 612	91 915
1994	167 584	153 035	98 605	251 640	55 923	133 203	189 126	5 119	95 764
1995	204 227	178 019	103 372	281 391	90 254	140 478	230 732	3 967	91 171
1996	241 751	192 877	117 914	310 791	154 697	159 860	314 557	4 179	93 373
1997	170 847	139 736	131 659	271 395	112 694	155 639	268 333	5 843	92 997
1998	150 019	129 750	135 737	265 487	52 250	145 358	197 608	6 458	87 466
1999	155 369	148 526	117 889	266 415	58 831	139 622	198 453	7 663	92 557
2000	143 303	159 192	125 141	284 833	50 900	148 428	199 328	7 028	81 365
2001(p)	149 429	125 185	101 637	226 822	69 092	126 652	195 744	5 109	. .

Sources: Natural Resources Canada; Statistics Canada.

. . Not available; (p) Preliminary.

(a) Lead in pigs, blocks and shot.

(1) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2603.00.20, 2607.00.20, 2608.00.20 and 2616.10.20. Refined exports include HS classes 7801.10, 7803.00, 7804.11, 7804.19 and 7804.20. Refined imports include HS classes 7801.10.10, 7801.10.90, 7803.00, 7804.11, 7804.19 and 7804.20.

(2) Recoverable lead in ores and concentrates shipped. (3) Primary and recycled in origin, as measured by a survey of users.

TABLE 3. ANNUAL AVERAGE LEAD PRICES, 1975-2001

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(US¢/lb)	(US$/t)	(US¢/lb)
1975	413.48	18.75	441.93	18.82
1976	451.51	20.48	469.03	21.28
1977	617.78	28.02	626.84	28.43
1978	658.87	29.89	659.07	29.90
1979	1 203.15	54.57	1 149.95	52.16
1980	909.12	41.24	911.46	41.34
1981	734.73	33.33	750.12	34.03
1982	544.08	24.68	562.53	25.52
1983	425.27	19.29	440.55	19.98
1984	444.36	20.16	445.25	20.20
1985	394.10	17.88	394.12	17.88
1986	406.89	18.46	407.26	18.47
1987	597.41	27.10	567.38	25.74
1988	655.83	29.75	635.68	28.83
1989	676.14	30.67	659.36	29.91
1990	817.85	37.10	790.82	35.87
1991	557.84	25.30	568.90	25.81
1992	540.04	24.50	553.56	25.11
1993	406.38	18.43	420.36	19.07
1994	549.01	24.90	564.10	25.59
1995	630.51	28.60	638.88	28.98
1996	773.96	35.11	771.22	34.98
1997	624.08	28.31	633.01	28.71
1998	528.42	23.97	533.29	24.19
1999	502.24	22.78	508.89	23.08
2000	454.22	20.60	468.07	21.23
2001	476.04	21.59	483.24	21.92

Source: International Lead and Zinc Study Group.

TABLE 4. LME MONTHLY AVERAGE LEAD PRICES, 2000 AND 2001

	London Metal Exchange			
	Settlement		Three Months	
	(US$/t)	(US¢/lb)	(US$/t)	(US¢/lb)
2000				
January	472.08	21.41	488.18	22.14
February	452.38	20.52	470.24	21.33
March	441.30	20.02	456.59	20.71
April	421.14	19.10	439.75	19.95
May	412.12	18.69	430.43	19.52
June	419.59	19.03	436.36	19.79
July	452.12	20.51	462.60	20.98
August	473.09	21.46	485.82	22.04
September	487.05	22.09	493.26	22.37
October	486.14	22.05	493.00	22.36
November	468.02	21.23	481.27	21.83
December	462.34	20.97	477.11	21.64
2001				
January	478.05	21.68	488.84	21.17
February	501.80	22.76	500.63	22.71
March	498.39	22.61	503.50	22.84
April	477.50	21.66	489.63	22.21
May	466.69	21.17	478.74	21.72
June	444.14	20.15	456.14	20.69
July	461.55	20.94	470.39	22.34
August	482.95	21.91	491.16	22.28
September	465.25	21.10	475.45	21.57
October	468.11	21.23	477.78	21.67
November	486.48	22.07	485.57	22.03
December	483.26	21.92	481.15	21.82

Source: International Lead and Zinc Study Group.

TABLE 5. MINE PRODUCTION OF LEAD, BY COUNTRY, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 t)		
EUROPE					
Bulgaria	32	22	14	14	16
Greece	19	23	19	16	27
Ireland	45	36	39	57	45
Italy	12	6	5	3	3
Macedonia	28	30	27	24	24
Poland	55	60	68	53	48
Romania	17	15	18	19	19
Russia	16	13	14	14	12
Spain	23	19	29	51	50
Sweden	109	112	118	107	88
Yugoslavia	14	16	9	4	4
Other Europe	7	5	–	–	–
Total Europe	377	357	361	362	336
AFRICA					
Morocco	77	80	80	82	91
Namibia	18	14	12	12	12
South Africa	83	84	80	75	51
Other Africa	2	4	8	8	8
Total Africa	180	182	180	179	162
AMERICAS					
Canada	186	190	162	149	154
Mexico	174	166	126	138	130
Peru	262	258	271	271	289
United States	459	491	513	466	459
Other Americas	195	180	39	37	38
Total Americas	1 129	1 146	1 111	1 061	1 070
ASIA					
China	712	581	549	570	599
India	33	38	38	36	32
Iran	19	17	17	17	16
Japan	5	6	6	9	5
Kazakhstan	29	26	31	39	43
North Korea	35	30	22	18	16
Thailand	6	7	12	11	–
Turkey	10	12	14	17	16
Other Asia	17	9	5	5	4
Total Asia	858	726	694	722	731
OCEANIA					
Australia	486	584	633	650	714
Total Western World	2 130	2 246	2 261	2 245	2 246
Total World	3 030	2 995	2 978	2 973	3 003

Sources: Natural Resources Canada; International Lead and Zinc Study Group.

TABLE 6. REFINED LEAD PRODUCTION, BY COUNTRY, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 t)		
EUROPE					
Belgium	111	92	110	119	100
Bulgaria	73	77	82	84	81
Czech Republic	22	24	25	28	28
France	283	289	273	262	230
Germany	329	353	353	387	375
Italy	212	199	215	231	222
Poland	65	64	64	56	58
Russia	52	36	44	32	58
Spain	90	94	98	120	122
Sweden	86	87	79	78	75
United Kingdom	399	370	372	338	382
Other Europe	168	167	170	147	144
Total Europe	1 890	1 852	1 885	1 882	1 875
AFRICA					
Morocco	64	62	65	67	54
South Africa	43	50	52	46	55
Other Africa	17	15	14	12	12
Total Africa	124	127	131	125	121
AMERICAS					
Brazil	53	48	52	50	47
Canada	271	266	266	284	231
Mexico	259	259	199	241	222
Peru	98	104	111	116	118
United States	1 431	1 436	1 447	1 471	1 374
Other Americas	70	69	61	68	63
Total Americas	2 182	2 182	2 136	2 230	2 055
ASIA					
China	708	757	918	1 034	1 172
India	60	66	64	67	63
Japan	297	302	293	312	302
Kazakhstan	82	92	159	208	170
Malaysia	36	29	33	32	38
North Korea	30	25	22	19	18
South Korea	182	180	190	220	211
Taiwan	36	39	45	42	40
Other Asia	171	163	164	158	170
Total Asia	1 602	1 648	1 882	2 092	2 184
OCEANIA					
Australia	229	200	271	259	271
New Zealand	6	6	6	5	5
Total Oceania	235	206	277	263	276
Total Western World	4 972	4 911	4 938	5 094	4 885
Total World	6 033	6 015	6 280	6 593	6 510

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 7. REFINED LEAD USE, BY COUNTRY, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 t)		
EUROPE					
Austria	61	67	55	61	58
Belgium	60	58	51	57	40
France	256	251	260	268	265
Germany	340	356	372	390	403
Ireland	29	26	32	30	32
Italy	259	262	279	279	284
Netherlands	57	51	30	29	30
Poland	57	59	64	59	60
Russia	103	92	95	83	94
Spain	170	188	192	231	246
United Kingdom	345	310	329	328	323
Other Europe	231	251	231	244	254
Total Europe	1 968	1 971	1 990	2 059	2 089
AFRICA					
Algeria	20	21	21	21	20
Egypt	9	8	8	9	9
South Africa	63	74	67	59	59
Other Africa	29	32	33	38	36
Total Africa	121	135	129	127	124
AMERICAS					
Brazil	110	110	108	114	112
Canada	71	67	70	68	55
Mexico	148	163	179	185	180
United States	1 664	1 742	1 793	1 805	1 686
Other Americas	112	116	100	109	97
Total Americas	2 105	2 198	2 250	2 281	2 130
ASIA					
China	485	505	524	590	650
India	88	95	112	119	127
Indonesia	66	53	45	66	51
Iran	68	64	65	68	70
Japan	330	308	289	301	284
Malaysia	73	62	76	84	82
South Korea	292	236	272	303	315
Taiwan	141	132	150	145	145
Thailand	48	46	66	96	82
Other Asia	180	179	198	207	218
Total Asia	1 771	1 681	1 798	1 980	2 024
OCEANIA					
Australia	63	54	56	41	41
New Zealand	7	10	8	9	9
Total Oceania	70	64	64	50	50
Total Western World	5 259	5 256	5 411	5 603	5 436
Total World	6 034	6 049	6 231	6 497	6 418

Sources: Natural Resources Canada; International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 8. WESTERN WORLD RECOVERY OF RECYCLED[1] LEAD, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 t)		
EUROPE					
Austria	22	23	24	23	22
Belgium	27	33	77	107	100
France	159	158	150	137	132
Germany	198	192	192	216	218
Ireland	12	13	11	9	10
Italy	146	142	148	163	164
Netherlands	19	17	18	21	20
Spain	90	94	98	120	122
Sweden	43	48	44	47	44
United Kingdom	189	184	183	182	183
Other Europe	42	39	40	36	34
Total Europe	947	943	985	1 061	1 049
AFRICA					
Algeria	7	6	6	6	6
Morocco	4	4	4	2	2
South Africa	43	50	52	46	49
Other Africa	9	9	7	6	5
Total Africa	63	69	69	60	62
AMERICAS					
Brazil	53	48	52	50	47
Canada	132	136	118	125	104
Mexico	80	87	91	79	80
United States	1 089	1 099	1 097	1 130	1 098
Other Americas	65	68	60	59	54
Total Americas	1 419	1 438	1 418	1 443	1 383
ASIA					
India	17	17	19	25	19
Indonesia	30	22	18	18	18
Iran	28	26	28	28	28
Japan	154	158	168	182	175
Malaysia	36	29	33	32	38
South Korea	61	47	50	50	50
Taiwan	36	39	45	42	40
Thailand	15	19	23	24	28
Other Asia	70	69	69	70	76
Total Asia	447	426	453	471	472
OCEANIA					
Australia	25	28	32	34	34
New Zealand	6	6	6	5	5
Total Oceania	31	34	37	38	39
Total Western World	2 907	2 910	2 963	3 073	3 005

Sources: Natural Resources Canada; International Lead and Zinc Study Group.

(p) Preliminary.

(1) Refined lead and lead alloys (lead content) produced from scraps, wastes and residues.

Lime

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"Lime" is a general term referring to burned or calcined limestone (burnt lime or quicklime) and its secondary products, including hydrated lime (calcium hydroxide), also referred to as slaked lime. In the calcining process, quicklime (CaO or CaO.MgO) begins to form at the dissociation temperature of limestone. Temperatures are maintained sufficiently long until there is a complete breakdown of the limestone and a release of the carbon dioxide content. High-calcium quicklime containing mainly CaO and less than 5% MgO is the most common type of lime produced. However, dolomitic quicklime (or dolime) and its hydrated products are also produced; these products contain 35-40% MgO.

CANADIAN INDUSTRY

Canadian shipments of all lime in 2001 amounted to 2.22 Mt valued at $212 million based on preliminary data. These amounts are about 12% lower than in 2000 (Tables 1 and 2). Quicklime accounted for about 90% of the total volume and value of shipments. Production figures do not include some captive production from pulp and paper plants that burn sludge to recover lime for re-use in the causticization process. Similarly, beginning with 1996 data, General Chemical Canada Ltd. has not been included in the production figures because this company's output, in some cases, is related to the manufacture of derived chemicals.

The lime industry in Canada comprises 14 operating plants from New Brunswick to British Columbia as of year-end 2001 (Figure 1 and Table 3). Two plants closed in 2001: the Hazel plant in Alberta, owned by Graymont Western Canada Inc., and the Haileybury plant in Ontario owned by Miller Minerals, a division of Miller Paving Limited. Total employment in the industry in 1999 (still the most recent year for which Statistics Canada data are available), was approximately 765, compared to 830 in 1998.

The Graymont group of companies, with seven plants across Canada and several plants in the United States, now accounts for an estimated 30% of total lime capacity in North America. Carmeuse North America Group, with complete or partial ownership of three plants in Ontario, is the leading producer of lime in North America. Chemical Lime Company of Canada Inc., with one operation in British Columbia, is the second largest lime producer in North America.

USE

The types or forms of lime commercially available are essentially the same as reported in detail in the chapter on lime appearing in the 1998 edition of the *Canadian Minerals Yearbook*.

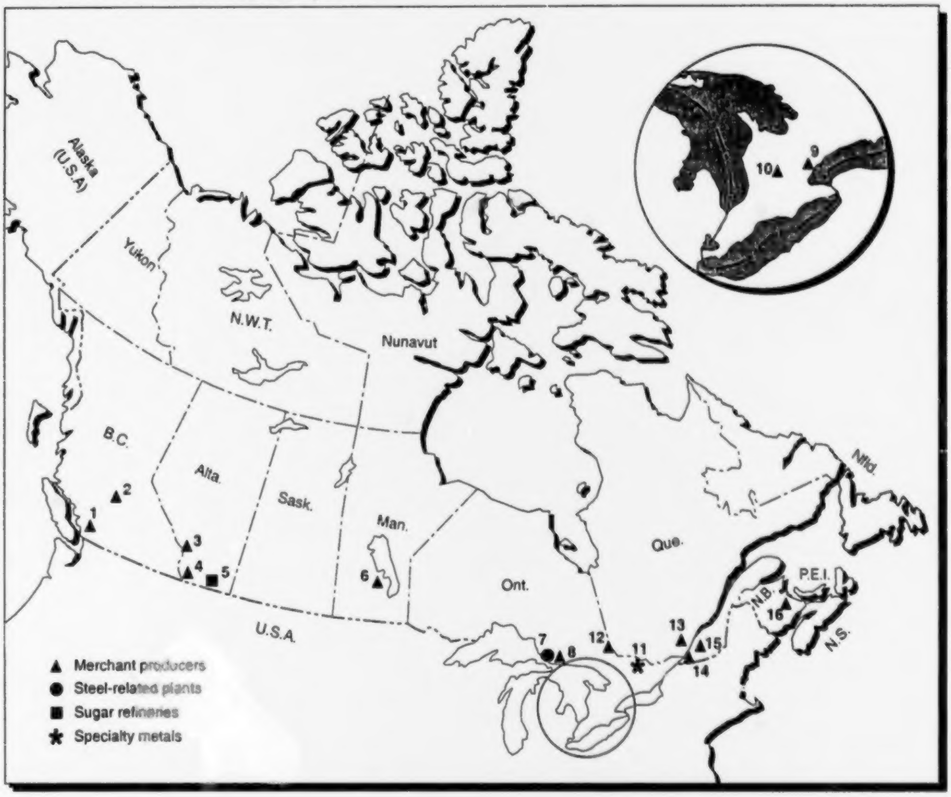
The use of lime in Canada, or essentially its complete consumption in the manufacture of numerous products, relates mainly to the merchant market, which is served by the mainstream lime producers.

The use of quicklime, based on reported shipments for the merchant market, amounted to 1 447 722 t in 2001. The major end uses were steel-making (41%), environmental control (13%), pulp and paper (19%), chemicals (12%), and other industrial uses, including metal concentration (15%). Hydrated lime shipments in the merchant market amounted to 135 836 t in 2001 and were sold mainly for environmental control (63%), other industrial uses (18%), agricultural uses (3%), and other miscellaneous uses related mainly to road and soil stabilization and other construction and masonry (15%).

ENERGY AND TECHNOLOGY

Energy costs to produce quicklime account for about 40% of total production costs, one of the highest ratios in the mineral processing sector. Calcining takes place mainly in vertical (shaft-type) kilns or rotary-type kilns, the latter technology being most common in North America. Preheater systems and

Figure 1
Lime Producers in Canada, 2001


Alaska (U.S.A)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
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6
7
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9
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11
12
13
14
15
16
▲ Merchant producers
● Steel-related plants
■ Sugar refineries
★ Specialty metals

Numbers refer to locations on map above.

MERCHANT PRODUCERS

1. Chemical Lime Company of Canada Inc., Fort Langley
2. Graymont Western Canada Inc., Pavilion Lake
3. Graymont Western Canada Inc., Exshaw
4. Graymont Western Canada Inc., Summit plant, Hazell[1]
6. Graymont Western Canada Inc., Faulkner
8. Carmeuse North America Group, Spragge
9. Lafarge Lime (Canada) Inc., Dundas Division
10. Carmeuse North America Group, Ingersoll
12. Miller Minerals, Haileybury[2]
13. Graymont (QC) Inc., Joliette
14. Graymont (QC) Inc., Bedford
15. Graymont (QC) Inc., Marbleton
16. Graymont (NB) Inc., Havelock

STEEL-RELATED PRODUCERS

7. Algoma Steel Inc., Sault Ste. Marie

SUGAR REFINERIES

5. Rogers Sugar Ltd., Taber

SPECIALTY METALS

11. Timminco Limited, Haley Station

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[1] Closed in October 2001.

[2] Closed in January 2001.

computerized process control systems are now commonplace.

About 50% of the kilns in service in Canada use natural gas, with petroleum coke, coal and heating oils accounting for the energy inputs required for the calcining process. Kiln efficiencies depend on the type of design and generally range from 4 to 5 gigajoules per tonne (GJ/t) of calcined lime for shaft kilns to as much as 13 GJ/t for long rotary kilns not equipped with preheaters. About 60% of carbon dioxide emissions relate to the decomposition of limestone (calcium carbonate) whereas the remaining 40% are energy-related emissions.

PRICES

Published prices for lime represent only a broad range. Actual prices vary according to marketing strategies and supply and demand. Average prices for high-calcium quicklime and high-calcium hydrated lime, f.o.b. plant, in Ontario, in bulk, were quoted at $70.80/t and $80.40/t respectively at the end of 2001.

INTERNATIONAL DEVELOPMENTS

World lime production was an estimated 115 Mt in 2001, compared to 116 Mt in 2000 (Table 5). China and the United States, accounting for 22 Mt and 19 Mt respectively, were followed by Germany and Japan, each with 7.6 Mt.

Canada ranks in the top 10 lime-producing countries because of relatively large chemical and industrial requirements, according to the final 2000 information. Reserves of limestone and related nonrenewable mineral/rock resources are relatively large; however, land-use constraints in some regions are becoming more onerous. The proximity of lime plants to U.S. markets has resulted in a favourable balance of trade in lime products throughout the period 1975-2000, as shown in Table 2.

The United States produced 18.7 Mt of lime in 2001, compared to 19.6 Mt in both 2000 and 1999, according to preliminary figures. Apparent use amounted to 18.8 Mt in 2001 compared to 19.6 Mt in 2000. Environmental uses for lime in the United States, which include flue gas sulphur removal, water treatment and waste-water treatment, have grown rapidly and are the third most important uses after metallurgical, chemical and industrial uses.

OUTLOOK

The production of lime in Canada in 2002 is expected to be about the same as the previous year based on higher demand by the steel industry, stable markets for pulp and paper, and a recovery in exports.

Lime is now marketed to several industries more as a specialty chemical than as a commodity because certain uses demand stricter specifications relating to ISO standards. In particular, these standards may apply to: 1) lime and dolime for steel-making; 2) the processing of lime for precipitated calcium carbonate (PCC) for a range of industrial uses; 3) lime for flue-gas desulphurization technology to make commercial-quality synthetic (FGD) gypsum; and 4) high-purity lime for water treatment. The use of lime in the environmental sector is expected to increase in the short term given the importance of treating effluents in the industrial and mining sectors.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 1, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2522.10	Quicklime	Free	Free	Free	Free
2522.20	Slaked lime	Free	Free	Free	Free
2522.30	Hydraulic lime	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, LIME PRODUCTION AND TRADE, 2000 AND 2001

Item No.		2000		2001(p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (1)					
	By type				
	Quicklime	2 271 277	209 696	2 011 500	188 833
	Hydrated lime	254 092	27 905	209 410	23 602
	Total	2 525 369	237 601	2 220 910	212 435
	By province/territory				
	Newfoundland and Labrador	–	–	–	–
	Prince Edward Island	–	–	–	–
	Nova Scotia	–	–	–	–
	New Brunswick	x	x	x	x
	Quebec	x	x	x	x
	Ontario	1 293 381	115 280	1 067 288	96 849
	Manitoba	x	x	x	x
	Saskatchewan	–	–	–	–
	Alberta	x	x	x	x
	British Columbia	x	x	x	x
	Yukon	–	–	–	–
	Northwest Territories	–	–	–	–
	Nunavut	–	–	–	–
	Total	2 525 369	237 601	2 220 910	212 435
IMPORTS (2)					
2518.20	Calcined dolomite				
	United States	3 810	761	19 436	2 683
	Canada	320	35	–	–
	Total	4 130	796	19 436	2 683
2522.10	Quicklime				
	United States	45 267	4 767	75 566	8 470
	Switzerland	218	23	219	28
	United Kingdom	–	–	71	11
	Canada	1	...	27	3
	India	7	1	11	2
	Finland	–	–	...	...
	Total	45 493	4 791	75 894	8 514
2522.20	Slaked lime				
	United States	7 054	1 538	5 548	1 281
	United Kingdom	–	–	2	1
	Japan	–	–	...	...
	France	51	15	–	–
	Total	7 105	1 553	5 550	1 282
2522.30	Hydraulic lime				
	United States	9 686	1 718	12 873	2 070
	Germany	–	–	2	1
	United Kingdom	13	4	–	–
	Italy	...	...	–	–
	Jordan	...	...	–	–
	Total	9 699	1 722	12 875	2 071

TABLE 1 (cont'd)

Item No.		2000		2001(p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
2518.20	Calcined dolomite				
	United States	15 749	4 112	11 134	4 648
	Total	15 749	4 112	11 134	4 648
2522.10	Quicklime				
	United States	68 236	9 625	87 588	14 297
	Total	68 236	9 625	87 588	14 297
2522.20	Slaked lime				
	United States	12 382	1 801	5 836	966
	France	5	1	2	1
	Total	12 387	1 802	5 838	967
2522.30	Hydraulic lime				
	United States	1	5	59	42
	China	7	3	31	14
	Total	8	8	90	56

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Producers' shipments and quantities used by producers. (2) Includes re-imports.
Notes: Numbers may not add to totals due to rounding. HS code 2522.30, as interpreted, applies mainly to hydrated lime.

TABLE 2. CANADA, LIME PRODUCTION, TRADE AND APPARENT USE, 1975, 1980 AND 1985-2001

	Production (1)					
	Quick	Hydrated	Total	Imports	Exports	Apparent Use (2)
			(tonnes)			
1975	1 533 944	199 195	1 733 139	30 099	234 034	1 529 204
1980	2 364 000	190 000	2 554 000	40 901	403 166	2 191 735
1985	2 054 294	157 286	2 211 580	23 056	194 097	2 040 539
1986	2 069 043	173 534	2 242 577	46 917	189 512	2 099 982
1987	2 140 793	189 278	2 330 071	44 290	163 767	2 210 594
1988 (a)	2 306 831	211 151	2 517 982	32 543	122 900	2 427 625
1989	2 349 312	202 622	2 551 934	39 095	83 608	2 507 421
1990	2 137 996	202 741	2 340 737	43 715	138 409	2 246 043
1991	2 184 836	190 424	2 375 260	45 012	134 405	2 285 867
1992	2 193 752	190 592	2 384 344	55 706	173 248	2 266 802
1993	2 186 749	192 247	2 378 996	52 690	190 068	2 241 618
1994	2 250 205	198 818	2 449 023	66 886	193 902	2 322 007
1995	2 244 800	216 916	2 461 716	52 884	266 475	2 248 125
1996	2 134 437	267 595	2 402 032	36 639	216 849	2 221 822
1997	2 219 385	257 186	2 476 571	47 382	224 232	2 299 721
1998	2 204 957	256 086	2 461 043	(r) 34 031	171 446	(r) 2 323 628
1999	2 299 705	265 746	2 565 451	54 535	96 058	2 523 928
2000	2 271 277	254 092	2 525 369	62 296	80 631	2 507 034
2001 (p)	2 011 500	209 410	2 220 910	94 319	93 516	2 221 713

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; (r) Revised.
(a) Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Imports and exports include HS classes 2522.10, 2522.20 and 2522.30.
(1) Producers' shipments and quantities used by producers. (2) Production plus imports, less exports.

TABLE 3. CANADIAN LIME INDUSTRY, 2001

Company	Plant Location	Calcining Capacity	Market	Type of Quicklime and Other Products
		(000 t/y)		
NEW BRUNSWICK				
Graymont (NB) Inc.	Havelock	175	Merchant	High-calcium (1)
QUEBEC				
Graymont (QC) Inc.	Marbleton	330	Merchant	High-calcium (1)
Graymont (QC) Inc.	Joliette	200	Merchant/captive	High-calcium (1)
Graymont (QC) Inc.	Bedford	200	Merchant	High-calcium
ONTARIO				
Algoma Steel Inc.	Sault Ste. Marie	200	Captive	High-calcium and dolomitic
Beachville Lime Limited	Ingersoll	600	Merchant	High-calcium (1) and dolomitic
Miller Minerals, a division of Miller Paving Limited (2)	Haileybury	40	Merchant	High-calcium
Northern Lime Limited	Spragge	200	Merchant	High-calcium and dolomitic
Lafarge Lime (Canada) Inc., Dundas Division	Dundas	345	Merchant	High-calcium and dolomitic
Timminco Limited	Haley Station	53	Captive	Dolomitic
MANITOBA				
Graymont Western Canada Inc.	Faulkner	117	Merchant	High-calcium
ALBERTA				
Rogers Sugar Ltd.	Taber	66	Captive	High-calcium
Graymont Western Canada Inc.	Exshaw	180	Merchant	High-calcium (1)
Graymont Western Canada Inc., Summit plant (3)	Hazell	50	Merchant	High-calcium and dolomitic (1)
BRITISH COLUMBIA				
Graymont Western Canada Inc.	Pavilion Lake	235	Merchant	High-calcium
Chemical Lime Company of Canada Inc.	Fort Langley	135	Merchant	High-calcium (1)

Source: Natural Resources Canada.
(1) Production of hydrated lime. (2) Closed in January 2001. (3) Closed in October 2001.
Note: Lantic Sugar Limited operates sugar refineries in Quebec and New Brunswick.

TABLE 4. CANADA, USE(1) OF DOMESTIC LIME, QUICK AND HYDRATED, 1998-2001

End Uses	1998	1999	2000	2001
			(tonnes)	
CHEMICAL AND INDUSTRIAL				
Steel-making	707 482	780 877	632 284	530 605
Water and sewage treatment	310 510	296 053	224 074	197 817
Water purification	48 366	51 323	37 445	48 420
Gas scrubbing	15 060	16 309	7 629	6 742
Metal concentration	158 482	138 431	153 469	176 213
Pulp and paper mills	200 824	213 627	218 878	253 287
Chemicals	193 693	194 362	161 408	163 070
Other industrial uses	96 416	101 102	109 645	44 765
CONSTRUCTION				
Road and soil stabilization	14 323	15 810	9 586	11 159
Mason and finishing lime	1 684	1 591	917	8 757
Other	17 807	22 126	11 259	3 096
AGRICULTURE	1 051	2 512	4 699	3 791
Total use	1 765 697	1 834 124	1 571 293	1 447 722

Source: Natural Resources Canada, based on producing companies' surveys, 1998-2001.
(1) Includes merchant market only; excludes companies that are completely captive producers/users.

TABLE 5. WORLD PRODUCTION OF QUICKLIME AND HYDRATED LIME, INCLUDING DEAD-BURNED DOLOMITE SOLD AND USED, 1997-2001

	1997	1998	1999	2000	2001(p)
			(000 tonnes)		
Canada	2 500	2 460	2 570	2 500	2 200
Brazil	5 700	5 700	5 700	5 700	6 300
China	20 500	21 000	21 500	21 500	22 000
France	2 800	2 800	2 400	2 400	2 400
Germany	8 000	7 600	7 600	7 600	7 600
Italy (1)	3 500	3 500	3 500	3 500	3 500
Japan (2)	7 850	8 100	7 750	7 700	7 600
Mexico	6 600	6 600	6 600	6 600	6 000
Poland	2 500	2 500	2 500	2 500	2 500
United Kingdom	2 500	2 500	2 500	2 500	2 500
United States	19 700	20 100	19 600	19 600	18 700
Other countries	37 850	33 050	33 650	33 995	33 500
Total	120 000	115 910	115 870	116 095	114 800

Sources: Natural Resources Canada; Statistics Canada; U.S. Geological Survey.

(p) Preliminary.

(1) Includes hydraulic lime. (2) Quicklime only.

Magnesium

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2001 Primary metal production:	$255 million^e
World rank:	Second
Exports:	$176 million

	1999	2000	2001
		(tonnes)	
Primary metal production capacity (1,e)	49 000	50 500	59 500
Exports (HS 8104)	49 747	47 181	43 292
Imports (HS 8104)	38 377	34 588	(r) 33 480

(e) Estimated; (r) Revised.
(1) Canadian magnesium production data are confidential due to the limited number of companies reporting. This number is based on published capacity for primary metal. Note that other published estimates of Canadian magnesium production include significant quantities of recycled material.

World production of primary and recycled magnesium decreased to an estimated 524 000 t in 2001, down 7% from an estimated figure of 564 000 t in 2000.[1] Prices for magnesium followed the trend from 2000 and generally weakened during the year, due mainly to the continued high levels of shipments from China.

The International Magnesium Association (IMA) reported that Western primary magnesium production (which excludes China, the former Soviet Union and Israel) decreased by 14% (29 514 t) to 180 750 t in 2001 from 210 300 t in 2000. That decrease was due to the closure of Northwest Alloys' plant in Washington and decreased production at Magnesium Corporation of America's plant in Utah. The IMA estimated world shipments of magnesium at 330 180 t in 2001, a decline of 10% compared to the estimated 366 900 t shipped in 2000. (Further information from the Association can be obtained on the Internet at www.intlmag.org.)

CANADIAN DEVELOPMENTS

Producers

In 2001, Canada was the second largest producer of primary metal in the world after China.

In early 2001, Magnola Metallurgy Inc. (owned 80% by Noranda Inc. and 20% by Société générale de financement du Québec) completed construction of its 58 000-t/y commercial magnesium plant in Danville, Quebec. The plant started producing magnesium metal from the residues of local asbestos mines in October 2000, creating 350 jobs. Magnola reports the metal produced at the plant is of high quality and that it has had excellent reviews from its customers.

While the company faced some start-up problems, many of the initial technical problems were resolved at the end of 2001. It was reported that the voltage in cells had been increased to 65% of power rate capacity in early 2002. The plant was operating 16 cells at the end of 2001 and Noranda reported that the plant produced 9339 t of pure magnesium and alloys in 2001. The company expected to produce 30 000 t of metal in 2002 and to reach full capacity rates by late 2002 (www.norandamagnesium.com).

Norsk Hydro Canada Inc. (Norsk Hydro), a wholly owned subsidiary of Norsk Hydro ASA of Norway, has produced magnesium metal at a 43 000-t/y Bécancour, Quebec, plant using an electrolytic process since 1989. The plant also recycles magnesium scrap produced by its customers. Norsk Hydro

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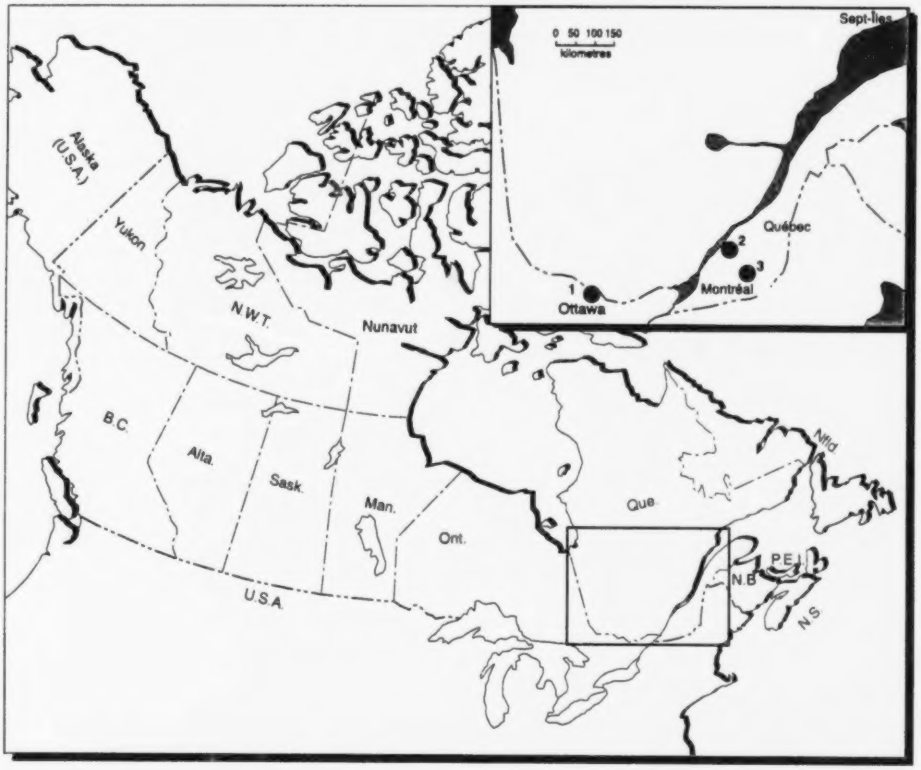
[1] Magnesium statistics vary between sources. Readers are cautioned to ensure data are appropriate for their needs. Including production figures published by the Chinese Magnesium Association, the totals would be 30 000 to 50 000 t higher. Note that statistics on magnesium use may include scrap components and may be/may have been over-stated. Work is under way to resolve these potential problems.

Figure 1
Magnesium Smelters, 2001



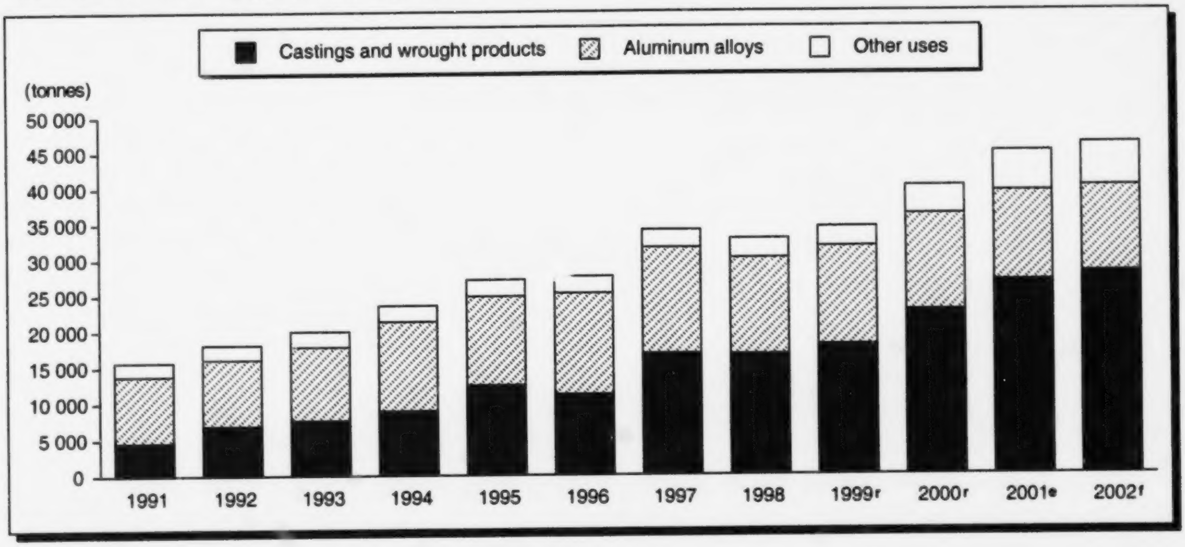
SMELTER	COMPANY	CAPACITY (t/y)
1. Haley Station, Ontario	Timminco Limited	6 000
2. Bécancour, Quebec	Norsk Hydro Canada Inc.	43 000
3. Danville, Quebec	Magnola Metallurgy Inc.	58 000

has focussed on debottlenecking the existing operations and making them more efficient, and this work was expected to increase capacity to 48 000 t/y in 2002. Expansion may take place in the future provided sufficient customer contractual commitments for the production are in place. Hydro Magnesium does not expect any large-scale increases to be initiated in the short term. Cost-cutting measures have been implemented at the plant and, as part of these measures, the company laid off 85 people in early 2001 (www.magnesium.hydro.com).

Timminco Limited operates a silicothermic reduction facility at Haley Station, Ontario. The operation includes a dolomitic limestone deposit and facilities for calcination, feed preparation, reduction, refining, and casting of magnesium ingots and billets. Processing facilities include an extrusion and anode fabrication and assembly plant, as well as magnesium billet and slab processing facilities. In 2001, Timminco restarted operations and achieved commercial production levels at the Haley casthouse, which had been damaged after a metal spill in late 2000. The new casthouse re-opened in early 2001 and the company continues to upgrade the facility. The casting facility at Haley provides magnesium billets for Timminco's extrusion facilities at Haley Station, Ontario, and Aurora, Colorado. On a longer-term basis, the company intended to expand operations in the wrought products area (www.timminco.com).

Canada's two largest magnesium producers have developed new magnesium alloys for use in higher temperature applications. With the continued

Figure 2
Canadian Use of Magnesium, 1991-2002



Source: Natural Resources Canada survey of Canadian users of magnesium.
e Estimated; f Forecast; r Revised.

involvement of metal producers in alloy development, increased uses will be found for magnesium on a longer term basis. Further information can be obtained from the Noranda Magnesium web site at www.norandamagnesium.com and from Norsk Hydro's web site at www.hydro.com.

In Canada, reported use of magnesium increased from a revised 40 154 t in 2000 to 44 925 t in 2001, due in part to an increased number of companies reporting. It should be noted that previously published figures on use have included some run-around scrap, which has been removed from data for 2001, and for 1999 and 2000, where known and significant. Work is nearing completion to ensure future data do not include these amounts.

Project Proposals

In Canada, as in the rest of the world, there has been continued interest in the production of magnesium metal from magnesite and dolomite deposits, and from previously mined asbestos deposits. The Canadian projects include: Globex Mining Enterprises Inc.'s magnesite-talc project at Timmins, Ontario; Leader Mining International Inc.'s project near Hope, British Columbia; Gossan Resources Limited at Inwood, Manitoba; Cassiar Resources Inc. at Cassiar, British Columbia; Canadian Magnesium Corporation at Baie Verte, Newfoundland and Labrador; and an asbestos-based project at Thetford Mines, Quebec.

Globex Mining Enterprises Inc. engaged Hatch Associates to complete a scoping study on Globex's Timmins area magnesium-talc deposit 13 km south of Timmins, Ontario. Previous work has indicated potential for the production of both magnesium metal and high-quality talc from the deposit. The study was completed in October 2001 and results were positive, indicating good economic potential. The study proposed a $1.5 billion mine smelter complex comprising a mine near Timmins, Ontario, and a smelter at Rouyn-Noranda, Quebec. The project has the advantages of access to competitively priced power; ready access to consumer markets; access to a stable, high-calibre work force; excellent infrastructure, including highways and railways; and a high-quality talc by-product, to provide additional revenue.

At year-end, Globex was reviewing the results in anticipation of conducting the recommended full bankable feasibility study with an expected cost of US$12 million for a mine-mill complex located near Timmins, Ontario, and a smelter complex located west of Rouyn-Noranda in Quebec. Further details are available on the Internet at www.globexmining.com.

Leader Mining International Inc. acquired property in 2001 over the Cogburn ultramafic intrusive near Hope, British Columbia, that contains magnesium-bearing silicates. Samples of outcrops were tested for extraction of magnesium and scoping-level studies were undertaken and completed in October with positive results. The study indicated a capital cost estimate of US$1.02 billion for a mine and smelter with a production rate of 120 000 t/y. A drilling program was under way at year-end and a number of contractors, including Hatch Associates, were engaged to complete studies by December 2002. Further details are available on the Internet at www.leadermining.com.

Cassiar Resources Inc. has a stockpile of 23 Mt of serpentine tailings that grade approximately 24% magnesium at the former Cassiar Asbestos Corporation Limited's mine at Cassiar in northern British Columbia. The metal project could be carried out in addition to the company's project to recover asbestos fibre from those tailings although, in December 2000, a fire damaged the fibre mill, slowing that project. In 2001, the company re-examined its options for reopening the mill and sought potential investors (www.cassiarresources.com).

Gossan Resources Limited has maintained its interest and added to its property holdings in a dolomite property at Inwood, Manitoba, with a dolomite resource estimated at 67 Mt grading 21.6% magnesium oxide with additional inferred resources. Tests on this material have shown that production of commercial-grade magnesium metal is possible using the Magnetherm process (www.gossan.ca).

Canadian Magnesium Corporation (CMC) has proposed a project to extract magnesium oxide from serpentine in the tailings at the former Baie Verte asbestos mine in Newfoundland and Labrador. In 1999, CMC completed pre-feasibility studies and bench-scale testing on mineral residues. Results of the work were positive and indicated that a clean product could be produced. The company continues to review its financing options prior to committing to piloting and marketing studies.

The town of Thetford Mines, Quebec, worked on a prefeasibility study for a proposal to process mining residues from asbestos mines into magnesium metal. The town reports that more than 300 Mt of material with a grade of approximately 24% magnesium is available in the area for processing. Work continued to find and license a process that could be used to extract the magnesium. Discussions were also under way with possible partners in the project.

WORLD DEVELOPMENTS

The major factor in magnesium markets remains the increased production and export of magnesium from China. Pressure on markets from this production has resulted in a general decrease in the price of magnesium and has caused the United States and the European Union to impose high import duties on Chinese magnesium. The pressure on prices, in combination with other factors such as environmental considerations, has caused three Western smelters to close, but has also increased the potential for growth in use.

China

Although a number of Chinese magnesium producers agreed in October 2001 to limit the production of magnesium to avoid continued surpluses of material, markets had not been noticeably affected at the time of writing. The prevalent low prices have caused a number of smaller plants to close in China. The remaining magnesium metal production capacity has been estimated at approximately 250 000 t/y. However, as most magnesium plants in China use a batch silicon thermal reduction process, the opening and closing of plants is relatively easy. In addition, the cost of ferrosilicon, an essential input into the production process, is relatively low within China, giving Chinese magnesium producers a cost advantage. Reported changes included:

- Norsk Hydro A/S completed construction of a 10 000-t/y magnesium alloy ingot foundry in China in Xi'an, approximately 800 km southwest of Beijing. Norsk Hydro started producing high-quality alloy ingot from locally produced magnesium for export to traditional markets for diecasting alloys. The plant will also eventually produce 400 t/y of anodes.

- China Steel Corp. announced that it planned to build a new magnesium plant.

- Gold River Magnesium planned to expand its capacity from 9000 t/y to 40 000 t/y over the next four years.

- Ningxia Zhongning Aluminium planned to expand capacity from 7000 t/y to 19 000 t/y in 2002.

- Jinghua Magnesium in Shanxi planned to expand alloy capacity by 10 000 t/y.

- Jishan Huayu Enterprises in Shanxi planned to increase its capacity to 16 000 t/y from 6000 t/y.

- The Quinghai provincial government proposed a new 50 000-t/y electrolytic smelter using brines from Chearhan Salt Lake, with the start of construction originally proposed for 2001 and production in 2005. At the end of the year, it was seeking investors in the project.

- Tongxian Magnesium in Shanxi planned to expand capacity to 30 000 t/y of pure magnesium from 17 000 t/y. The first phase to reach 20 000 t/y was completed in 2001.

- Wenxi Yinguang Magnesium planned to expand capacity from 24 000 t/y to 28 000 t/y of pure metal and alloys in 2002.
- Xinlihua Magnesium Powder Company planned to increase its ingot capacity to 6000 t/y from 3000 t/y.
- Zunyi Titanium Works started production of magnesium and planned to produce at a rate of 5000 t/y and to increase its production of titanium.

Western Producers

Norsk Hydro has closed the 42 000-t/y Porsgrunn magnesium smelter in Norway. The existing casthouse will operate based on scrap and ingot remelt feedstock for magnesium alloy production. The Porsgrunn casthouse has a 20 000-t/y remelt capacity, which will remain open. Further information is available on the Internet at www.magnesium.hydro.com.

Pechiney Electrometallurgie has announced the closure of the 18 000-t/y Marignac magnesium smelter in France (www.pechiney.com).

Alcoa Inc. closed the 38 000-t/y Northwest Alloys magnesium smelter in Addy, Washington (www.alcoa.com).

Magnesium Corp. of America filed for protection from its creditors under Chapter 11 of the bankruptcy code. The company is modernizing equipment at its 43 000-t/y smelter in Rowley, Utah, to reduce emissions. Modernization of the plant is expected to eventually increase its capacity but, in the near term, production has been reduced.

Governments

The U.S. International Trade Administration determined, after a review, that imports of pure magnesium from China were sold at less than market value and determined duty margins of 24.67% for Minmetals and 305.56% country-wide.

The U.S. Department of Commerce (DOC) determined that sales of pure magnesium from Israel were made at less than fair value and determined countervail duty margins of 13.39% and anti-dumping at 12.68%. A subsequent determination of higher rates was countered by the U.S. International Trade Commission. A final determination was also made of a 0% margin on imports from Russia.

In late 2000, the Government of Quebec filed a request for a review by an independent binational panel under Chapter 19 of the North American Free Trade Agreement (NAFTA) of decisions resulting from a five-year sunset review in 2000. In early 2002, the Panel remanded the final results to the DOC to reconsider its determinations (www.usitc.gov and www.nafta-sec-alena.org).

In early 2001, the United States Automotive Materials Partnership (USAMP), as part of the United States Council for Automotive Research (USCAR), began a new structural cast magnesium development project to resolve the critical issues that limit the large-scale application of structural cast magnesium castings in automotive components. In addition, work was conducted though the Partnership for a New Generation of Vehicles (PNGV) on new power train components, including ones from cast magnesium alloys, although the focus of work shifted to the FreedomCAR Research Partnership in early 2002. The vision of FreedomCAR is petroleum-free cars and light trucks (www.uscar.org).

PROJECTS

Australia

Australian Magnesium Corporation (AMC), after some difficulty and government assistance of about A$300 million in the last year, completed financing for construction of a 90 000-t/y plant at Stanwell, Queensland. The company expected to start construction in 2002. Metal production is expected to start in late 2004 and the plant is expected to reach full capacity in 2006. AMC has decided to use newer Alcan Ex2 cells, which have a higher capacity for production of magnesium than the older versions of this technology. For further information, see the company's web site at www.austmg.com and Australian government sites at www.minister.industry.gov.au and www.qld.gov.au.

Mt. Grace Resources NL continued work on its Northern Territory Batchelor magnesium project 85 km south of Darwin. Mt. Grace's stage one feasibility study proposed that an initial A$76 million plant with a 14-MW furnace could have a capacity of 12 500 t/y of metal. Once the plant is running, depending on market conditions, the company would expand the operation to 50 000 t/y in 2007. The company planned to complete a bankable feasibility study by the end of 2001 and has signed an agreement for the sale of 10 000 t/y of metal with the Frank & Schulte Group, a subsidiary of Stinnes Interfer, which is a division of Stinnes AG, one of Germany's largest companies. The project received Major Project Facilitation status from the government and the company hoped to begin construction in 2002 with first production in 2003 (www.mtgrace.com).

Pima Mining/Samag Ltd. continued work on a proposed metal plant based on magnesite deposits located near Leigh Creek in the Willouran Ranges region of South Australia. Samag has increased the size of its initial proposal and now expects to construct an A$700 million, 65 000-t/y smelter using Dow technology in Port Pirie, South Australia. The company received environmental approval from the South Australian government and secured a power contract with Australian National Power, which will build a 230-MW power station and provide up to 170 MW to the project. The company also received commitments that the South Australian government would spend up to A$25 million to improve infrastructure. The company expected to complete a bankable feasibility study in 2002 and start construction, with metal production anticipated for 2004. The company also held discussions with possible investors and studied construction of a metal plant in New Zealand (www.mgil.com.au).

Pacific Magnesium Corporation Ltd. (formerly Golden Triangle Resources NL) continued work on its Woodsreef magnesium project in New South Wales based on feed from asbestos tailings. The company planned to proceed with a definitive feasibility study on the Woodsreef project that would be completed in late 2001. The company also held discussions with possible partners (www.pacificmagnesium.com).

Rambora Technologies planned to conduct a prefeasibility study on a 100 000-t/y smelter based on high-magnesium fly ash from the Hazelwood Power station in the Latrobe Valley, Victoria. The company also held discussions with the Victorian government and worked on financing for the project.

Indcor Limited (formerly Crest Magnesium NL) shelved its plans for a proposed 60 000-t/y magnesium metal plant near Bell Bay, Tasmania (www.indcor.com.au).

Netherlands

Antheus Magnesium BV continues to work on its magnesium metal production facility in the Delfzijl region. The company has commissioned a feasibility study for a 30 000-t/y plant and is seeking partners in the plant, which is hoped to be in production in 2005 (www.antheusmagnesium.nl).

Republic of the Congo (Brazzaville)

Magnesium Alloy Corporation (MagAlloy) continued work on its Kouilou project in the Republic of the Congo (Brazzaville). The project is based on two exploration permits in the Kouilou region where previous work has indicated the presence of potassium and magnesium salts. The company proposes a 60 000-t/y plant in Pointe-Noire to solution mine the salt beds and produce magnesium metal with by-product chlorine, sodium chloride and potassium chloride to provide additional revenue. The Russian National Aluminium and Magnesium Institute (VAMI) and the Ukrainian Titanium Institute's magnesium extraction technology would be used in the plant. A government decree signed by the President in June was expected to help the project.

Magnesium Alloy Corporation signed a Memorandum of Understanding with Siemens Aktiengesellschaft Power Transmission and Distribution Division regarding several areas of cooperation. The company also entered into a framework agreement with Amphora Group Holding Luxembourg S. A. for funding, implementation and development of the project and related energy infrastructure. However, in November, the company announced termination of that agreement . At year-end, the company was continuing discussions with other potential investors in the project. MagAlloy planned to begin production by 2005 at a rate of 60 000 t/y of pure and alloyed metal (www.magnesiumalloy.ca).

Ukraine

After finding a new investor, the Kalush magnesium plant, originally with a capacity of 24 000 t/y, was expected to re-open in 2002. The production rate was expected to be about 10 000 t/y.

Russia

Solikamsk Magnesium Works continued work on a 15 000-t/y expansion of capacity.

RECYCLING

Several new magnesium recycling facilities and expansions of existing facilities were under way or announced during 2001 and early 2002. These include:

- Magnesium Elektron completed the first phase of construction of its new 10 000-t/y magnesium recycling plant in Prague, in the **Czech Republic**, using scrap from Germany (www.luxfer.com and www.magnesium-elektron.com).
- Xstrata AG completed construction and started production of recycled magnesium at a 25 000-t/y plant in Anderson, Indiana – its first scrap recycling facility in the **United States**.

CHANGING TECHNOLOGY

Lakefield Research, based in Ontario, has been conducting research into new technology for magnesium production. The LRP process uses a simple reactor for leaching, neutralization, separation and washing of residues to simplify magnesium recovery from serpentine ores. The company sought an industrial partner to support further development of the technology (www.lakefield.com).

PRICES

Prices published by *Metals Week* for magnesium were relatively flat through the year. The U.S. Spot Western Mean started the year at US$1.26/lb and ended it at US$1.25/lb, while the mean U.S. dealer import prices decreased from US$1.10/lb early in the year to US$1.07/lb in December. The *Metal Bulletin*'s World Free Market Price for minimum 99.8% magnesium metal started the year at US$1950-$2050/t and declined steadily to end the year at US$1775-$1875/t.

Norsk Hydro's European producer price for pure magnesium started the year at €2.33/kg and, after declining to €2.22/kg in January, rose to €2.42/kg in July.

Reported prices of Chinese magnesium on a spot basis f.o.b. China started the year at approximately US$1500/t. Prices weakened further in 2001 with reported sales at US$1200-$1300/t (US54¢-59¢/lb) at year-end.

ANNUAL AVERAGE PRICES, METALS WEEK (U.S. SPOT WESTERN MEAN)

1997	1998	1999	2000	2001
		(US$/lb)		
1.65	1.59	1.55	1.37	1.25

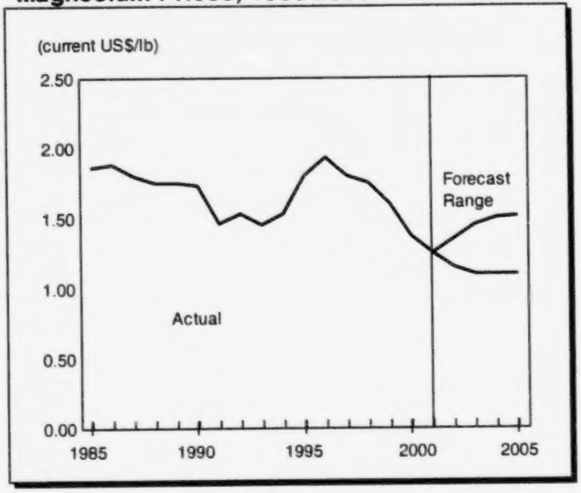
STOCKS

IMA data indicate that reported inventories of primary magnesium decreased slightly in 2001 to end the year at 45 180 t, down from 46 500 t at the end of 2000. This inventory represents approximately 50 days of world production of primary magnesium.

OUTLOOK

The biggest potential for growth in the use of magnesium lies in the aluminum alloy and automotive market sectors. The amount of magnesium used in automotive applications is relatively low compared to the use of other materials. Although some models contain larger quantities of magnesium, the average vehicle has been estimated to contain approximately 5 kg, while the plastic content is estimated at over 100 kg. As a result, a relatively minor increase in magnesium used in automotive parts could result in a large increase in magnesium use. However, growth will be dependent on prices and price stability as magnesium continues to face stiff competition from other materials, including aluminum, steel and plastics, in the all-important automotive parts sector.

Figure 3
Magnesium Prices, 1985-2005



Sources: Natural Resources Canada; *Metals Week* (U.S. Spot Western Mean).

A number of projects around the world, primarily focussed in Australia, could, if all constructed, significantly increase magnesium production. With the plants currently under construction, world primary magnesium production is expected to rise from about 410 000 t in 2001 to approximately 550 000 t/y by 2006 and potentially higher if many new projects achieve their goals.

Western World primary magnesium production is again expected to fall in 2002 as the closures of plants in the United States, Norway and France will not be countered by increases in production in plants in the United States and Canada. However, with the currently prevailing low metal prices, it is expected that the increasing use of magnesium in die casting and the increasing intensity of use, particularly in automotive applications, should continue to grow in the short to medium term.

Given the rapid decline in Western World production, it is possible that magnesium prices may increase on a short-term basis. It is likely, however, that spot prices will remain weak and potentially volatile on a medium-term basis until new widespread transportation use increases demand and production volumes of the metal.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of March 30, 2002. (3) Some differences are noted in some data from independent sources. Work is under way to determine the reasons for these differences. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS(1)

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States (2) Canada	EU (2) MFN
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime	7.50%	3%	Free	Free	6.50%
3824.90.90.43	Other granular metallic magnesium coated with inorganic salts	7.50%	3%	Free	Free	6.50%
8104.11	Magnesium unwrought, containing by weight at least 99.8% of magnesium	2.50%	Free	Free	Free	5.30%
8104.19	Magnesium unwrought, other					
8104.19.10	Magnesium-rare earth, magnesium-didymium, magnesium-thorium, magnesium-zirconium and magnesium-thorium-neodymium-rare earth for use in the manufacture of magnesium castings	Free	Free	Free	Free	4%
8104.19.90	Other	2.50%	Free	Free	Free	4%
8104.20	Magnesium waste and scrap	Free	Free	Free	Free	Free
8104.30	Magnesium raspings, turnings and granules, graded according to size; powders	2.50%	Free	Free	Free	4%
8104.90	Other magnesium	2.50%	Free	Free	Free	4%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (41st Annual Edition: 2001); *Custom Tariff Schedules of Import Duties for* Japan (35th Annual Edition: 2001).

(1) Does not include countervail or anti-dumping duties, which may be applied to material of certain origin. (2) Duty suspension may apply for certain goods. (3) WTO rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, MAGNESIUM EXPORTS AND IMPORTS BY COMMODITY AND COUNTRY, 2000 AND 2001

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	Germany	1 783	6 467	4 638	12 928
	United States	3 098	15 047	1 625	8 053
	Netherlands	17	50	2 547	6 143
	Austria	1 190	4 003	1 700	4 838
	Japan	1 368	5 350	1 236	3 722
	United Kingdom	331	2 292	315	2 449
	Other countries	(r) 371	(r) 1 333	1 785	4 849
	Total	(r) 8 158	(r) 34 542	13 846	42 982
8104.19	Magnesium unwrought, other				
	United States	21 273	105 641	13 858	64 149
	Netherlands	226	1 243	783	3 084
	Italy	73	404	305	1 643
	United Kingdom	92	627	112	771
	Other countries	1 360	5 228	491	1 587
	Total	23 024	113 143	15 549	71 234

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
8104.20	Magnesium waste and scrap				
	United States	6 450	19 316	8 585	27 083
	Australia	–	–	34	202
	Other countries	638	1 982	2	5
	Total	7 088	21 298	8 621	27 290
8104.30	Magnesium raspings, turnings or granules, graded according to size, and powders				
	United States	5 993	17 943	1 571	6 496
	Ireland	231	1 794	290	2 210
	North Korea	60	372	121	716
	Other countries	514	3 444	160	1 229
	Total	6 798	23 553	2 142	10 651
8104.90	Magnesium and articles thereof, other				
	United States	1 842	10 439	2 5[illegible]	20 169
	Australia	182	1 076	520	3 357
	Other countries	89	664	50	542
	Total	2 113	12 179	3 134	24 068
	Total exports	(r) 47 181	(r) 204 715	43 292	176 225
IMPORTS					
3824.90.90.42	Granular metallic magnesium coated with inorganic salts, mixed with lime				
	United States	742	3 437	607	2 376
8104.11	Magnesium unwrought, containing by weight at least 99.8% magnesium				
	China	(r) 3 907	(r) 9 243	7 458	18 121
	United States	2 738	11 421	2 701	10 506
	Russia	4 030	15 015	2 769	9 985
	Israel	747	3 110	687	2 315
	Brazil	719	2 818	340	1 140
	Other countries	593	2 175	450	1 500
	Total	(r) 12 734	(r) 43 782	14 405	43 567
8104.19	Magnesium unwrought, other				
	United States	(r) 4 478	(r) 22 019	2 444	12 316
	Norway	3 173	13 833	1 939	7 369
	Russia	. . .	2	1 288	5 383
	United Kingdom	(r) 181	(r) 2 273	239	2 393
	China	(r) 2 028	(r) 9 417	143	965
	Other countries	934	4 067	44	182
	Total	(r) 10 794	(r) 51 611	6 097	28 608
8104.20	Magnesium waste and scrap				
	United States	6 860	24 758	7 530	28 945
	Russia	(r) 726	(r) 3 158	2 563	9 839
	Israel	1 031	2 860	238	722
	Other countries	(r) 156	(r) 561	189	575
	Total	(r) 8 773	(r) 31 337	10 520	38 081
8104.30	Magnesium raspings, turnings or granules, graded according to size and powders				
	United States	474	2 217	692	3 317
	Switzerland	21	80	19	68
	Other countries	17	70	20	80
	Total	512	2 367	731	3 465
8104.90	Magnesium and articles thereof, other				
	United States	(r) 959	(r) 8 998	941	7 839
	China	53	338	173	1 057
	Other countries	21	165	35	146
	Total	(r) 1 033	(r) 9 501	1 149	9 042
	Total imports	(r) 33 846	(r) 156 246	32 902	141 428

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, MAGNESIUM USE,[1] 1995-2001

	1995 (a)	1996	1997	1998 (a)	1999 (a)	2000 (a)	2001 (p)
							(tonnes)
Castings and wrought products (2)	12 488	11 197	16 795	16 687	(r) 17 951	(r) 22 728	26 818
Aluminum alloys	12 323	14 022	14 793	13 417	13 741	13 466	12 551
Other uses (3)	2 329	2 357	2 438	(r) 2 685	2 727	3 960	(a) 5 556
Total	27 140	27 576	34 026	(r) 32 790	(r) 34 419	(r) 40 154	44 925

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised.
(a) Increase in number of companies being surveyed.
(1) Available data as reported by users. (2) Die, permanent mould and sand castings, structural shapes, tubings, forgings, sheet and plate.
(3) Cathodic protection, reducing agents, deoxidizers and other alloys.
Note: Numbers may not add to totals due to rounding.

TABLE 3. WORLD PRODUCTION OF MAGNESIUM, 1995-2001

Country	Rank in 2001	1995	1996	1997	1998	1999	2000	2001 (e)
					(000 tonnes)			
PRIMARY PRODUCTION								
China (2)	1	93.6	73.2	76.0	70.5	120.7	142.1	150.0
Canada (1,e)	2	48.1	54.0	57.7	77.1	80.0	80.0	70.0
United States	3	142.1	133.1	124.8	106.1	75.0	94.0	45.0
Russia	4	37.5	31.5	33.0	34.1	35.2	35.5	40.0
Norway	5	28.0	37.8	34.2	35.4	40.8	41.4	35.0
Israel	6	–	(r) 0.1	7.4	24.5	(r) 24.3	31.7	35.0
Kazakhstan	7	9.0	13.4	17.9	20.9	(r) 11.0	10.4	15.0
France	8	14.5	14.0	13.8	14.7	(r) 16.2	16.7	8.0
Brazil	9	9.7	9.0	9.0	9.0	(r) 8.0	5.7	8.0
India	10	1.0	1.0	1.0	1.5	1.5	1.5	1.5
Serbia & Montenegro	11	2.6	3.1	3.9	4.0	1.2	1.3	1.5
Ukraine	12	13.0	12.9	7.7	5.0	–	–	–
Japan	13	–	–	–	–	–	–	–
Total primary		399.1	(r) 383.1	386.4	402.8	413.9	460.3	409.0
RECYCLED PRODUCTION (3)								
United States	1	65.1	71.2	77.6	77.1	(r) 86.1	82.3	85.0
Japan	2	11.8	21.2	22.8	20.0	20.0	20.0	23.0
Brazil	3	1.6	1.6	1.6	1.6	1.6	1.6	2.0
United Kingdom	4	0.5	0.5	0.5	0.5	(r) 0.5	0.5	5.0
Austria	5	0.1	–	–	–	–	–	–
Total recycled		79.1	94.5	102.5	99.2	(r) 108.2	104.4	115.0
Total primary and recycled		478.2	(r) 477.6	488.9	502.0	(r) 530.5	674.7	524.0

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics; industry publications.
– Nil; (e) Estimated by author; (r) Revised.
(1) Estimate per USGS, includes recycled. (2) Numbers used in table are from the International Consultative Group on Nonferrous Metal Statistics. China Magnesium Association reports higher numbers for Chinese production: 1994 - 25 000 t; 1997 - 92 000 t; 1998 - 120 000 t; 1999 - 157 000 t; 2000 - 194 000 t; 2001 - 195 000 t. (3) Recycled magnesium facilities exist in other locations, including Canada, which have not reported separate production figures for recycled magnesium due to confidentiality reasons and other considerations.

Mercury

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Named after the Roman god of commerce, travel and thievery, mercury has been used for more than 3000 years. Its chemical symbol, Hg, comes from the Latin word *hydrargyrum* meaning "liquid silver." Also known to many as quicksilver, mercury was known to the ancient Chinese and Hindus before 2000 B.C. It has also been found in tubes in Egyptian tombs dating from about 1500 B.C. The first recorded mention of the metal was by Aristotle in the fourth century B.C. when the heavy, silvery white metal was used to form amalgams with other metals. It was also used in ointments and cosmetics.

Until the 1960s, mercury was used primarily as a flowing mercury cathode for the electrolysis of an aqueous sodium chloride solution to yield chlorine and caustic soda. Process losses to the environment became a concern and many chlor-alkali plants were either closed or converted to diaphragm cell or ion exchange technologies. Worldwide demand for this application continues to be the single largest use for mercury, but it is declining as older facilities are being closed and replaced with mercury-free technology.

Batteries are another major market for mercury that is experiencing a decline as manufacturers switch to alternative metals. The third but also shrinking market for mercury is in electrical applications. Uses range from metallic mercury switches in thermostats to mercury-vapour discharge lamps. Other uses include dental amalgams, temperature- and pressure-measuring devices, detonators, pigments and pharmaceuticals. Increased concerns related to the risks of exposure to human health and the environment have led to increased restrictions on the uses of mercury; however, its unique properties will likely guarantee its use in some key sectors, such as energy-efficient flourescent lamps, for the foreseeable future.

Mercury is a naturally occurring element that is unique amongst the metals in that it is liquid at ambient temperature. At room temperature, mercury is a silvery white colour. It is solid white below its melting point of -38.9°C and is a colourless gas above its boiling point of 356.9°C. Mercury exists in nature in some 25 different minerals but is most commonly recovered from the red sulphide mineral known as cinnabar (HgS). Other common mercury ores include corderoite and livingstonite. Native mercury metal exists in nature but is rare. Mercury deposits are generally formed at relatively low temperatures in the world's major orogenic belts.

MERCURY IN CANADA

Since the closure of Cominco Ltd.'s Pinchi Lake mine in 1975, Canada no longer produces primary mercury metal and it has been primarily an imported commodity. With the increase in concern related to environmental releases of mercury, the use of mercury in Canada continues to decline. In 1998, the last year publicly available data were published, Canada used a total of 2.8 t of metallic mercury, primarily for applications in electrical apparatus, industrial and control instruments, and for the electrolytic preparation of chlorine at the one remaining chlor-alkali plant for use in the pulp and paper industry. The use of mercury for applications such as gold recovery, industrial chemicals, and paints and pigments has been phased out. Canada exported 8 t of mercury in 2001 valued at $17 000, compared to 4.0 t in 2000 worth $25 000. Imports totalled 0.4 t valued at $7000 in 2001, the same as in 2000.

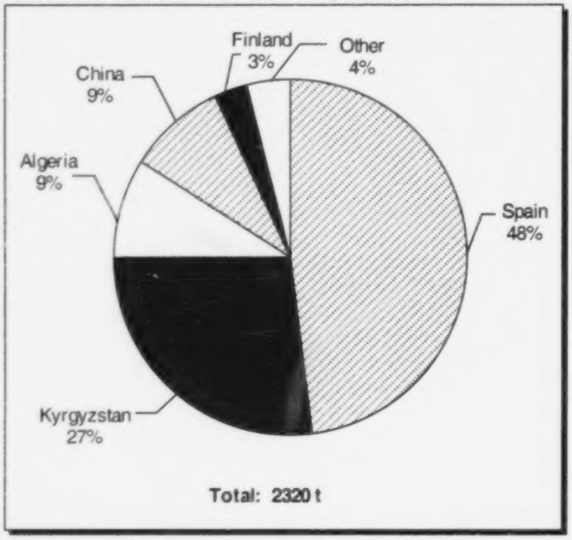
WORLD DEVELOPMENTS

World production of mercury has been declining steadily over the past few years. Total world production was 2320 t in 2000, compared to 2543 t in 1999. Spain is the world's largest producer followed by Kyrgyzstan, Algeria and China. Together these four countries accounted for just over 92% of the world's total production of mercury in 2000. Mercury recovered from primary sources accounts for about 60% of world use with the remainder supplied from recycled sources.

In the United States, about 15 t of mercury are recovered as a by-product of gold mining in Nevada, California and Utah. Recycled production greatly outweighs production from primary sources. Sales of mercury by the Defense Logistics Agency (DLA) from the National Defense Stockpile remained suspended in 2001 pending the completion of an analysis of the potential environmental impact of the sales.

Elsewhere in the world, mines in Slovenia, Turkey and the Ukraine remained closed. By-product production from mining continues in Finland, Tajikistan, Mexico and Chile. The decommissioning of mercury chlor-alkali plants in Europe and elsewhere remains a significant source of recycled mercury. Plant closures in Finland, Norway, the United Kingdom and South Africa have contributed some 360 t since 1997. Further plant closures and conversions are planned. There are some 100 mercury cell chlor-alkali plants still in operation worldwide.

Figure 1
World Production of Mercury, 2000



Source: International Consultative Group on Nonferrous Metals Statistics.

PRICE AND OUTLOOK

The commercial unit for handling mercury is the "flask," which weighs 34.47 kg (76 lb). Prices for mercury peaked in 1988 at US$335.52/flask and have since declined. Mercury prices reached their lowest level in September 1991 at US$85/flask. North American mercury prices started 2001 at US$135-$150/flask, rose slightly in June and remained at $154/flask to the end of the year (for lots sold containing 50 flasks or more). North American prices are expected to remain in the $140-$160/flask range in 2002. In the longer term, prices are expected to remain relatively stable as demand in mercury's remaining markets stabilizes.

Notes: (1) Information in this review was current as of April 19, 2002. (2) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TARIFFS

Item No.	Description	Canada MFN	Canada GPT	Canada USA	United States Canada
2617.90.00.90	Mercury ores and concentrates	Free	Free	Free	Free
2805.40	Mercury	Free	Free	Free	Free
2825.90.10.20	Mercury oxides	4%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, MERCURY TRADE, 1999-2001, AND USE, 1998-2000

Item No.		1999 (kg)	1999 ($000)	2000 (kg)	2000 ($000)	2001 (p) (kg)	2001 (p) ($000)
EXPORTS							
2805.40	Mercury						
	United States	1 778	8	4 108	25	8 045	17
	Total	1 778	8	4 108	25	8 045	17
IMPORTS							
2805.40	Mercury						
	United States	9 150	82	11 664	92	6 709	62
	Spain	–	–	–	–	665	3
	Germany	258	3	21	. . .	–	–
	Other countries	26	. . .	24	. . .	46	. . .
	Total	9 434	85	11 709	92	7 420	65
2825.90.10.20	Mercury oxides						
	United States	522	9	419	7	416	7
	Germany	635	11	16	. . .	22	. . .
	United Kingdom	127	2	–	–	–	–
	Switzerland	–	–	2	. . .	–	–
	Total	1 284	22	437	7	438	7

	1998 (kg)	1999 (kg)	2000 (p) (kg)
USE (metal) (1)			
Electrical apparatus, industrial and control instruments	x	x	x
Electrolytic preparation of chlorine and caustic soda and other uses	x	x	x
Total	2 803	x	x

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Available data as reported by users.
Note: Numbers may not add to totals due to rounding.

TABLE 2. WORLD PRODUCTION OF MERCURY, 1995-2000

Country	1995	1996	1997	1998	1999	2000 (p)
			(tonnes)			
Algeria	295.1	368.1	490.4	224.1	240.3	215.6
Chile	9.0	5.0	4.0	5.0	6.5	7.0
China	780.0	508.0	835.0	225.0	196.0	203.0
Finland	90.2	88.1	63.0	54.0	55.0	77.1
Kyrgyzstan	380.0	660.0	611.0	629.1	628.5	630.0
Mexico	15.0	15.0	15.0	15.0	15.0	15.0
Slovenia	–	5.0	5.0	5.0	–	–
Spain	1 497.0	1 052.8	863.0	675.0	1 351.9	1 093.7
Tajikistan	50.0	45.0	40.0	35.0	35.0	40.0
Ukraine	40.0	30.0	–	–	–	–
United States	15.0	15.0	15.0	15.0	15.0	15.0
Total world	3 171.3	2 792.0	2 941.4	1 902.2	2 543.2	2 320.4

Sources: Natural Resources Canada; International Consultative Group on Nonferrous Metals Statistics.
– Nil; (p) Preliminary.

Mineral Aggregates

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Total Canadian shipments of regular weight mineral aggregates in 2001 have been estimated to be 342 Mt, based on preliminary data, compared to 350 Mt in 2000, based on final data. Specifically, these data relate to the combined amounts of crushed stone and miscellaneous stone and sand and gravel, essentially all for construction uses (Table 1, By Use, and Table 2, respectively). Relevant subtotals of shipments of crushed stone and miscellaneous stone by rock type, e.g., limestone, granite and other types of stone, are included in a separate commodity chapter entitled "Stone."

The federal budget for 2001 announced the creation of a Strategic Infrastructure Foundation having a minimum federal commitment of $2 billion to assist large infrastructure projects and encourage public-private partnerships. This funding program is in addition to the Infrastructure Canada Program, which has been allocated $2.05 billion over six years (2000-01 to 2005-06). The latter is a cost-shared program expected to result in total construction-related spending of about $6 billion when combined with contributions from other partners.

Trade in construction aggregates, mainly with the United States, is growing in importance in Atlantic Canada and British Columbia. The level of funding planned under the U.S. *Transportation Equity Act for the 21st Century* remains uncertain; however, this is not expected to affect markets for strategically located producers in Canada.

The demand for construction aggregates in 2002 is expected to be about the same as the previous year because growth in residential construction will be offset by a decline in non-residential building. The average unit values of construction aggregates shipped, as reported by producers, generally continued to increase in pace with the rate of inflation, with selling prices varying considerably depending on proximity to consumers.

Information on lightweight aggregates, including ferrous slags, is included in Tables 6-11, inclusive.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 2, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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TABLE 1. CANADA, TOTAL PRODUCTION OF STONE, 1999-2001

Item No.	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	3 091	20 206	4 505	27 859	3 794	27 677
Nova Scotia	7 881	48 064	8 379	51 246	8 413	51 949
New Brunswick	4 388	23 141	3 294	19 429	4 003	17 201
Quebec	30 269	218 744	31 550	229 984	32 508	240 411
Ontario	51 258	385 675	58 704	474 155	59 861	471 779
Manitoba	4 314	20 089	4 007	19 688	3 424	17 092
Saskatchewan	–	–	x	x	x	x
Alberta	465	4 623	x	x	x	x
British Columbia	7 440	54 505	6 636	49 172	6 663	47 923
Northwest Territories	78	452	186	2 952	187	2 535
Total	109 184	775 499	118 222	881 260	119 805	884 081
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	315	41 031	360	50 388	. .	. .
Monumental and ornamental stone (n.f.)	88	7 939	111	10 598	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	104	13 550	105	16 311	. .	. .
Total dimension stone	507	62 520	576	77 297	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	20 718	122 299	21 830	131 073	. .	. .
Asphalt aggregate	11 097	69 608	11 509	72 753	. .	. .
Road metal	30 663	165 040	36 478	192 907	. .	. .
Railroad ballast (includes traprock)	1 830	15 437	1 681	14 375	. .	. .
Other uses	34 873	181 907	36 061	201 603	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 082	50 085	14 776	44 570	. .	. .
Cement plants, foreign	525	1 919	539	2 273	. .	. .
Flux in iron and steel furnaces	1 295	10 476	680	6 279	. .	. .
Flux in nonferrous smelters	101	818	100	1 519	. .	. .
Glass factories	163	2 739	51	738	. .	. .
Lime plants, Canada	5 261	19 877	3 184	19 513	. .	. .
Lime plants, foreign	1 229	6 269	1 437	8 586	. .	. .
Pulp and paper mills	96	1 120	118	1 271	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 550	9 360	1 763	12 777	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	3	120	2	68	. .	. .
Roofing granules	751	27 309	873	37 348	. .	. .
Poultry grit	176	1 775	173	1 427	. .	. .
Stucco dash	25	2 682	23	3 985	. .	. .
Terrazzo chips	7	303	9	666	. .	. .
Rock wool	26	424	25	431	. .	. .
Rubble and riprap	942	4 415	1 257	4 476	. .	. .
Other uses	1 090	8 506	1 562	8 245	. .	. .
Pulverized stone						
Whiting	274	9 956	44	3 971	. .	. .
Asphalt filler	178	247	200	363	. .	. .
Dusting coal mines	2	145	1	51	. .	. .
Agricultural purposes and fertilizer plants	1 049	15 377	1 113	18 500	. .	. .
Other uses	897	58 632	1 064	82 428	. .	. .
Total crushed stone	128 903	786 848	136 554	872 196	. .	. .
Total all stone	129 410	849 368	137 130	949 493	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary.
(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) Data include stone used in the Canadian cement, lime and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, PRODUCTION OF SAND AND GRAVEL,(1) BY PROVINCE AND TERRITORY, 1999-2001

Item No.	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Newfoundland and Labrador	(r) 3 718	(r) 9 875	2 911	12 371	2 924	12 128
Prince Edward Island	257	1 258	258	1 260	258	1 260
Nova Scotia	2 250	10 605	2 547	11 591	2 549	11 670
New Brunswick	4 492	13 190	3 356	10 716	3 041	10 356
Quebec	30 274	83 473	31 569	84 438	27 429	77 326
Ontario	105 714	408 321	99 848	395 832	96 466	390 272
Manitoba	10 428	29 989	9 571	26 968	9 128	26 855
Saskatchewan	11 094	37 865	11 064	39 151	11 700	44 905
Alberta	41 229	195 630	42 372	208 591	40 123	206 439
British Columbia	32 615	164 019	33 872	174 742	30 741	166 704
Yukon	807	2 105	1 087	2 966	1 378	3 428
Northwest Territories	374	4 453	446	2 535	254	1 837
Total	(r) 243 250	(r) 960 785	238 901	971 159	225 991	953 181

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised.
(1) Production represents shipments of natural gravel, sand and crushed gravel. Does not include shipments to Canadian cement plants.
Note: Numbers may not add to totals due to rounding.

TABLE 3. AVAILABLE DATA ON USE OF SAND AND GRAVEL, BY REGION, 1999 AND 2000

	Year	Atlantic Provinces	Quebec	Ontario	Western Provinces (1)	Canada
				(000 tonnes)		
Road bed, surface	1999	4 210	18 097	42 086	47 324	111 717
	2000	3 335	20 584	35 969	48 867	108 754
Roads, ice control	1999	655	672	3 024	2 107	6 458
	2000	496	681	1 999	2 494	5 670
Concrete aggregate	1999	1 769	3 477	13 030	16 180	34 457
	2000	1 583	3 648	13 969	18 586	37 786
Asphalt aggregate	1999	634	2 648	8 154	10 021	21 457
	2000	877	2 460	8 070	11 026	22 433
Railroad ballast	1999	22	19	4	210	255
	2000	–	4	2	132	138
Mortar sand	1999	42	206	1 367	239	1 853
	2000	46	315	1 032	253	1 645
Backfill for mines	1999	286	21	1 244	249	1 801
	2000	364	139	1 210	181	1 893
Fill	1999	1 409	2 970	11 429	7 173	22 981
	2000	1 117	2 255	9 352	5 231	17 954
Other purposes	1999	853	2 165	25 770	13 246	42 034
	2000	1 326	1 485	28 391	11 685	42 886
Total	1999	9 880	30 274	106 109	96 751	243 013
	2000	9 143	31 569	99 993	98 455	239 160

Source: Natural Resources Canada.
– Nil.
(1) The western provinces include the Yukon and Northwest Territories.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, EXPORTS AND IMPORTS OF SAND AND GRAVEL AND CRUSHED STONE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	452 415	5 060	456 377	4 736	512 754	4 266
	Cayman Islands	–	–	–	–	37 307	789
	Chile	56	17	–	–	231	82
	Trinidad and Tobago	101	16	202	33	99	17
	Mexico	76	24	–	–	2	. . .
	Saint Pierre and Miquelon	30	10	–	–	–	–
	Iceland	4 313	285	–	–	–	–
	Malaysia	39	14	–	–	–	–
	Venezuela	427	156	455	99	–	–
	Bahamas	41 220	968	61 811	1 258	–	–
	Bermuda	16 066	153	–	–	–	–
	Barbados	53 538	1 719	–	–	–	–
	Philippines	–	–	201	30	–	–
	Argentina	–	–	313	67	–	–
	Total	568 281	8 422	519 359	6 223	550 393	5 154
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	3 287 916	33 381	3 130 583	31 944	4 884 125	48 362
	Barbados	15 832	467	–	–	27 644	757
	France	–	–	–	–	5	11
	Venezuela	–	–	–	–	13	. . .
	Germany	57	1	–	–	–	–
	Iceland	3 715	243	–	–	–	–
	Bahamas	45 865	1 103	47 239	1 079	–	–
	Bermuda	4 743	50	18 965	191	–	–
	Japan	–	–	6	47	–	–
	Jamaica	–	–	44 631	931	–	–
	Panama	–	–	536 580	1 258	–	–
	Total	3 358 128	35 245	3 778 004	35 450	4 911 787	49 130
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	267 109	37 943	347 873	56 015	49 078	8 983
	France	85	15	–	–	–	–
	Total	267 194	37 958	347 873	56 015	49 078	8 983
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated						
	Bahamas	–	–	–	–	26 050	649
	United States	1 427	118	100 810	6 089	9 347	612
	Other countries	39 728	1 021	43	14	123	8
	Total	41 155	1 139	100 853	6 103	35 520	1 269
2518.10	Dolomite, not calcined						
	United States	2 082 332	21 650	2 800 364	28 836	2 872 450	30 076
	Venezuela	75 889	1 034	423 821	4 436	292 434	3 250
	Mexico	227 070	2 022	311 456	2 771	142 974	1 336
	Trinidad and Tobago	–	–	109 469	1 976	38 738	740
	Romania	5	94	73	14	91	18
	Brazil	–	–	26 445	161	–	–
	Total	2 385 296	24 800	3 671 628	38 194	3 346 687	35 420
2518.20	Calcined dolomite						
	United States	29 466	6 696	15 749	4 112	11 134	4 648
	India	110	30	–	–	–	–
	Total	29 576	6 726	15 749	4 112	11 134	4 648

TABLE 4 (cont'd)

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)							
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	2 521 646	16 487	2 856 799	18 632	2 360 689	15 517
	Mexico	–	–	35 322	293	61 543	531
	India	–	–	–	–	4 694	24
	Cuba	–	–	–	–	237	. . .
	Total	2 521 646	16 487	2 892 121	18 925	2 427 163	16 072
IMPORTS							
2505.90	Natural sands n.e.s., excluding metal-bearing sands						
	United States	301 865	7 981	322 305	9 110	131 667	7 285
	South Africa	1	. . .	171	30	15 820	1 836
	China	160	44	492	128	1 270	307
	Australia	30	7	59	13	1 349	80
	Philippines	533	35	239	51	216	44
	France	99	9	4	1	143	30
	United Kingdom	1 320	46	168	41	144	25
	Other countries	851	128	2 652	107	207	30
	Total	304 859	8 250	326 090	9 481	150 816	9 637
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.						
	United States	(r) 3 171 469	(r) 17 708	3 085 293	16 859	3 052 765	16 265
	Israel	–	–	18 364	74	50 045	216
	China	7 674	73	8 976	137	16 025	212
	Norway	–	–	–	–	17 000	135
	United States (minor outlying islands)	–	–	–	–	17 041	61
	United Kingdom	1 316	49	695	67	2 600	52
	France	1 578	14	1 979	20	5 684	35
	Brazil	494	5	280	3	261	26
	India	3	. . .	36	1	143	18
	Germany	219	2	19	1	1 038	13
	Philippines	1 035	12	2 527	48	1 237	13
	Other countries	1 611	13	9 109	104	1 139	15
	Total	(r) 3 185 399	(r) 17 876	3 127 278	17 314	3 164 978	17 061
2517.20	Macadam of slag, dross or similar industrial waste, etc.						
	United States	5 209	34	30 179	229	8 399	61
	Other countries	317	2	1 464	11	99	1
	Total	5 526	36	31 643	240	8 498	62
2517.30	Tarred macadam						
	United States	119	6	158	7	539	22
	Total	119	6	158	7	539	22
2517.41	Marble granules, chippings and powder of 25.15 or 25.16, heat-treated or not						
	United States	88 377	15 207	58 918	10 395	73 317	15 546
	Italy	155	25	187	22	75	12
	Other countries	112	18	96	18	22	4
	Total	88 644	15 250	59 201	10 435	73 414	15 562
2517.49	Granules, chippings and powder, n.e.s., of 25.15 or 25.16, heat-treated						
	United States	25 852	1 324	28 480	1 614	25 437	1 519
	France	109	10	210	25	1 027	80
	China	58	6	105	11	367	35
	Brazil	191	23	545	35	420	29
	Other countries	359	36	718	45	608	28
	Total	26 569	1 399	30 058	1 730	27 859	1 691

TABLE 4 (cont'd)

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)							
2518.10	Dolomite, not calcinated						
	United States	3 329	659	4 784	866	3 579	698
	Other countries	20	7	82	22	17	3
	Total	3 349	666	4 866	888	3 596	701
2518.20	Calcined dolomite						
	United States	3 078	615	3 810	761	19 436	2 683
	Canada	756	86	320	35	–	–
	Total	3 834	701	4 130	796	19 436	2 683
2518.30	Agglomerated dolomite (including tarred dolomite)						
	United States	159	44	556	181	556	187
	Other countries	–	–	103	37	70	25
	Total	159	44	659	218	626	212
2521.00	Limestone flux; limestone and other calcareous stone used for lime or cement						
	United States	(r) 4 140 469	18 286	4 026 594	17 806	4 378 082	19 771
	France	4 077	15	57 466	70	4 947	24
	Other countries	12 187	49	49 844	249	14 680	55
	Total	(r) 4 156 733	18 350	4 133 904	18 125	4 397 709	19 850

Source: Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 5. LIGHTWEIGHT AGGREGATE PRODUCERS IN CANADA, 2000

Company	Location	Commodity	Remarks
ATLANTIC PROVINCES			
Fafard Peat Moss Company Ltd.	Inkerman, N.B.	Perlite, vermiculite	Processed for use in horticulture.
Sun Gro Horticulture Canada Ltd.	Maisonnette, N.B.	Perlite	Processed for use in horticulture.
QUEBEC			
Normiska Corp.	Lachine, Que. (plant)	Vermiculite, perlite	Vermiculite processed for use in loose insulation, horticulture and concrete products. Perlite processed for use in horticulture.
Premier Horticulture	Rivière-du-Loup	Perlite, vermiculite	Processed for use in horticulture.
Perlite Canada Inc.	Baie-du-Febvre	Perlite, vermiculite	Processed for use in horticulture.
ONTARIO			
Grace Canada, Inc.	Ajax	Vermiculite, perlite	Vermiculite processed for use in horticulture, as loose insulation, and in friction materials. Perlite processed for use in gypsum plaster, horticulture, refractories and as loose insulation.
Lafarge Canada Inc., Hamilton Slag Division	Hamilton	Slag	Used in concrete products industry.
PRAIRIE PROVINCES			
Cindercrete Products Ltd.	Saskatoon, Sask.	Expanded clay	Processed for concrete products industry.
Grace Canada, Inc.	Winnipeg, Man.	Vermiculite, perlite	Perlite processed for use in gypsum plaster, loose insulation and in horticulture.
	Edmonton, Alta.	Vermiculite, perlite	Vermiculite processed for use in horticulture and in fricton material and loose insulation.
Inland Cement Limited	Calgary, Alta.	Expanded shale	Processed for concrete products industry and for loose insulation.
	Edmonton, Alta.	Expanded clay	Processed for concrete products industry, and for loose insulation.
Sun Gro Horticulture Canada Ltd.	Elma, Man.	Perlite	Processed for use in horticulture.
	Seba Beach, Alta.	Perlite, pumice	Processed for use in horticulture.
BRITISH COLUMBIA			
Canada Pumice Corporation	Nakzo, Quesnel	Pumice	A range of pumice products for construction and landscaping material.
Great Pacific Pumice Inc.	Mt. Meager	Pumice	Used in horticulture, concrete products industry and as loose insulation.
Ocean Concrete Products Limited	Vancouver	Pumice	Purchased for concrete products industry.

Source: Natural Resources Canada, reported from NRCan 2000 annual survey questionnaire "Production of Lightweight Aggregates in Canada."

TABLE 6. CANADA, IMPORTS AND EXPORTS OF VERMICULITE, PERLITE AND PUMICE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	–	–	–	–	. . .	5
	Total	–	–	–	–	. . .	5
2530.10	Vermiculite, perlite and chlorites, unexpanded						
	Chile	8	6	14	8	24	13
	Dominican Republic	–	–	–	–	5	10
	United States	89	49	34	17	–	–
	Netherlands	2	21	–	–	–	–
	Trinidad and Tobago	–	–	1	. . .	–	–
	Total	. .	76	. .	25	. .	23
IMPORTS							
2513.11	Pumice stone, crude or in irregular pieces, including crushed pumice						
	United States	4 807	782	4 985	804	5 814	742
	Turkey	3 877	504	5 298	684	3 423	344
	Other countries	159	25	149	26	81	18
	Total	8 843	1 311	10 432	1 514	9 318	1 104
2513.19	Pumice stone, other						
	United States	2 861	600	3 817	677	3 302	643
	South Korea	87	17	170	46	542	70
	China	211	44	121	30	227	65
	Other countries	563	120	525	128	384	72
	Total	3 722	781	4 633	881	4 455	850
2530.10.00.10	Vermiculite, unexpanded						
	South Africa	18 628	4 749	11 115	2 663	22 090	5 631
	United States	13 196	2 445	16 532	2 918	14 742	2 967
	Greece	1 792	227	181	21	1 066	152
	Other countries	1 990	327	1 066	202	148	40
	Total	35 606	7 748	28 894	5 804	38 046	8 790
2530.10.00.20	Perlite, unexpanded						
	United States	33 955	6 435	27 854	4 961	29 714	5 858
	Greece	23 915	2 632	20 974	2 554	37 589	3 859
	Other countries	–	–	24	10	–	–
	Total	57 870	9 067	48 852	7 525	67 303	9 717
3802.90.00.20	Activated perlite, excluding expanded perlite ground to be employed in						
	United States	438	218	503	288	638	364
	Total	438	218	503	288	638	364
6806.20.00.10	Exfoliated (expanded) vermiculite						
	United States	487	1 873	449	1 619	388	1 396
	Other countires	23	53	1	4	17	42
	Total	510	1 926	450	1 623	405	1 438
6806.20.00.20	Expanded perlite						
	United States	8 383	(r) 5 934	9 636	6 766	10 073	7 427
	Other countries	–	–	9	4	25	41
	Total	8 383	(r) 5 934	9 645	6 770	10 098	7 468

Source: Statistics Canada.
– Nil; . . Not available; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, LIGHTWEIGHT AGGREGATES PRODUCED, SOLD AND USED, 1999 AND 2000

	1999				2000			
	Produced		Sold and Used		Produced		Sold and Used	
	(m³)	($)	(m³)	($)	(m³)	($)	(m³)	($)
From domestic and/or imported raw materials								
Expanded clay, shale and slag (1)	391 352	11 192 017	371 934	10 168 975	392 029	11 018 236	389 398	10 873 433
From imported crude materials								
Expanded perlite and exfoliated vermiculite (1)	658 770	35 304 186	662 770	35 548 186	675 602	38 778 030	708 095	41 036 475
Total	1 050 122	46 496 203	1 034 704	45 717 161	1 067 631	49 796 266	1 097 493	51 909 908

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada" (see Table 5 for list of establishments surveyed).

(1) Combined to avoid disclosing confidential company data.

TABLE 8. CANADA, SALES OF EXPANDED SLAG, PERCENTAGE BY END USE, 1998-2000

Use	1998	1999	2000
		(%)	
Concrete block manufacture	72.6	90.0	90.0
Ready-mix concrete	5.3	10.0	10.0
Miscellaneous uses	22.1	–	–

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments
Sales also imply quantities consumed for own use.

TABLE 9. CANADA, SALES OF EXPANDED CLAY AND SHALE, PERCENTAGE BY END USE, 1998-2000

Use	1998	1999	2000
		(%)	
Concrete block manufacture	44.2	52.7	50.1
Loose insulation	52.2	43.4	43.2
Precast concrete manufacture	1.2	2.0	2.0
Ready-mix concrete	1.1	2.0	0.7
Horticulture and miscellaneous uses	1.2	–	4.0

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 10. CANADA, SALES OF EXPANDED PERLITE, PERCENTAGE BY END USE, 1998-2000

Use	1998	1999	2000
		(%)	
Horticulture and agriculture	94.7	93.9	94.0
Loose insulation and miscellaneous uses	4.7	5.7	5.5
Insulation in gypsum products	0.6	0.4	0.5

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
– Nil.
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

TABLE 11. CANADA, SALES OF EXPANDED VERMICULITE, PERCENTAGE BY END USE, 1998-2000

Use	1998	1999	2000
		(%)	
Horticulture	83.6	78.9	84.8
Loose insulation	2.9	2.6	3.0
Miscellaneous uses	13.6	18.5	12.2

Source: Natural Resources Canada, reported from NRCan survey questionnaire "Production of Lightweight Aggregates in Canada."
Notes: See Table 5 for list of establishments surveyed. Sales also imply quantities consumed for own use.

Nickel

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(Author notes: [1] For more detailed information about Canadian facilities, refer to the Nickel chapter of the "2000 Canadian Minerals Yearbook." [2] Only material related to events in 2001 is covered in this review. [3] This chapter includes some information about cobalt as it relates to nickel; it does not provide a comprehensive review of cobalt.)

Abbreviations used in this review include:

Co Cobalt; Fe Iron; FeNi Ferronickel; PAL Pressure acid leach; Ni Nickel; PGMs Platinum group metals.

OVERVIEW

World nickel mine production increased by 3.2%. World production of refined and finished nickel increased by 6.1%. Nickel use (formerly called "consumption") decreased by 2.2%. Prices peaked in mid-May, bottomed out in early October and then recovered to US$5680/t by year-end.

Cobalt data are less well documented than nickel data. A principal source of world information is The Cobalt Development Institute (CDI) <www.thecdi.com>. Data from the CDI are shown in Table 9, which shows cobalt production for the period 1996 to 2001.

A list of Canadian nickel producers, their web sites, and the locations from which Canadian securities filing information can be obtained are provided in Table 3.

WORLD NICKEL DATA

	2000	2001
	(000 t)	
Mine production	1 183	1 221
Finished production	1 082	1 148
Usage (consumption)	(r) 1 123	1 098

Source: International Nickel Study Group (INSG), *World Nickel Statistics - April 2002* (data rounded to nearest 1000 tonnes).
(r) Revised.
Note: Refer to Tables 8, 9 and 10 in this article for data from 1996 to 2000.

LME ASK PRICES, 2001

	Cash	3 month	15 month	27 month
		(US$/t)		
Average	5 948	5 877	5 799	5 789
Maximum	10 660	10 380	8 655	7 540
Minimum	7 030	6 730	6 280	5 765

Sources: INSG; London Metal Exchange (LME).
Notes: Cash ask price = settlement price. Refer to Figure 2 for a graph of nickel prices in 2001 and for the period 1986-2001.

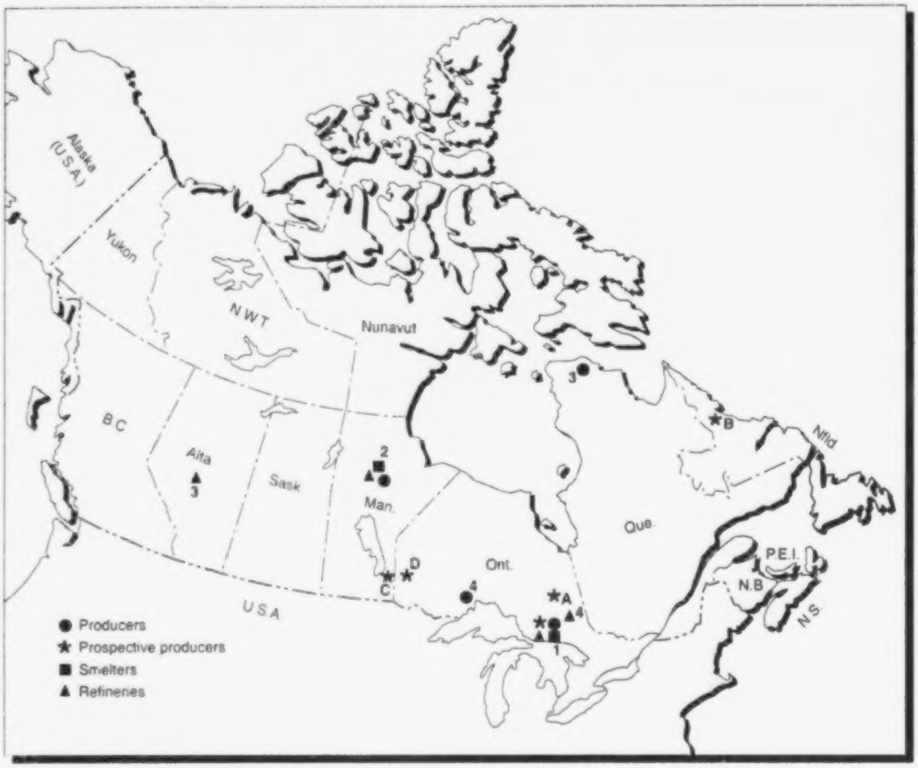
CANADIAN DATA

	2000	2001
	(t)	
Ni mine production (1)	(r) 190 793	193 361
Ni in concentrates shipped (2)	(r) 181 139	183 643
Ni refined production (3)	134 225	140 591
Ni usage (4)	(r) 24 976	. .
Co mineral production (2)	(r) 2 022	2 048
Co metal production (3)	6 307	5 008
Co usage (4)	127	. .

. . Not available; (*r*) Revised.
Ni = nickel; Co = cobalt.
(1) Metal in concentrates produced from Canadian mines.
(2) Recoverable metal in concentrates shipped from Canadian mines. (3) Metal produced, whether from domestic or foreign origin. (4) Use includes metal in scrap and other recycled forms.

Figure 1

Nickel and Cobalt in Canada, 2001


Alaska (U.S.A.)
Yukon
N W T
Nunavut
B C
Alta
Sask
Man.
Ont.
Que.
Nfld
P.E.I.
N.B
N.S
U S A
1
2
3
3
4
4
A
B
C
D
● Producers
★ Prospective producers
■ Smelters
▲ Refineries

Numbers and letters refer to locations on map above.

PRODUCERS

1. Falconbridge Limited (Fraser, Lindsley, Onaping-Craig, Lockerby)
1. Inco Limited (Lower Coleman, Copper Cliff North, Copper Cliff South, Crean Hill, Creighton, Garson, McCreedy East, Stobie)
2. Inco Limited (Thompson, Birchtree)
3. Falconbridge Limited (Raglan)
4. North American Palladium Ltd. (Lac des Iles)

SMELTERS

1. Falconbridge Limited (Falconbridge)
1. Inco Limited (Copper Cliff)
2. Inco Limited (Thompson)

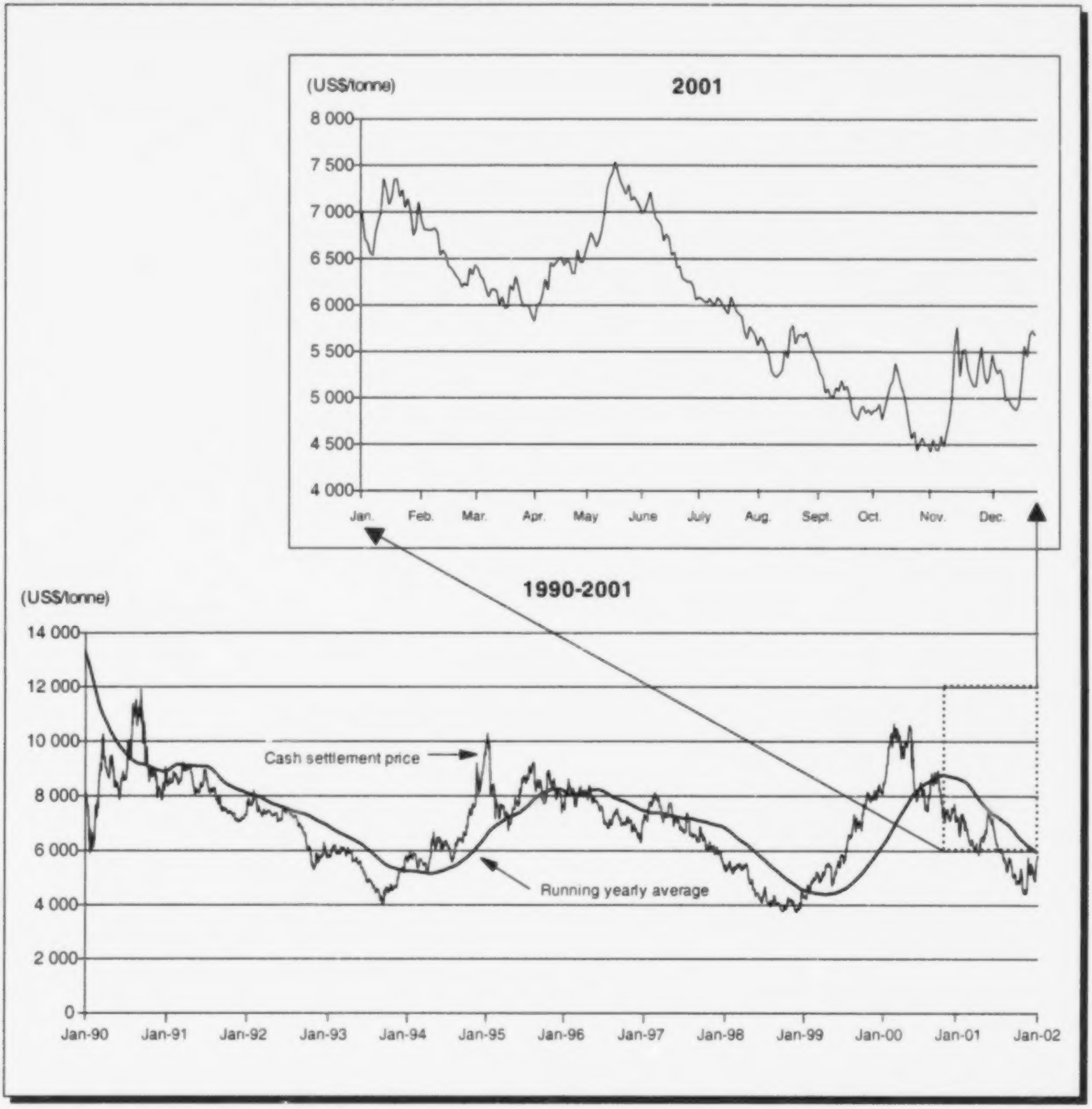
REFINERIES

1. Inco Limited (Sudbury)
2. Inco Limited (Thompson)
3. Sherritt International Corporation (Fort Saskatchewan)
4. Canmine Resources Corporation (Cobalt, Ontario)

PROSPECTIVE PRODUCERS

A. Outokumpu Mines Ltd. (Moncalm Township) (mine)
B. Inco Limited (Voisey's Bay mine)
C. Canmine Resources Corporation (Maskwa) (mine)
D. Canmine Resources Corporation (Werner Lake) (mine)

Figure 2
LME Cash Settlement Nickel Prices, 1990-2001



Sources: International Nickel Study Group, Reuters; World Bureau of Metal Statistics.
Conversions: $2.50/lb = $5512/t; $3.00/lb = $6614/t; $3.50/lb = $7716/t; $4.00/lb = $8818/t.

Canadian mine production of nickel (nickel contained in concentrates produced) was 193 361 t in 2001, up from 190 793 t in 2000. Primary nickel production in Canada was 140 591 t, up from 134 225 t in 2000 (Table 1). The locations of Canadian nickel production facilities are shown in Figure 1.

Canadian exports and imports of various forms of nickel are shown in Table 1a; some data refer to contained nickel and other data refer to gross weights, according to the definitions of the *Harmonized Commodity Description and Coding System* (Harmonized System) for trade classification. Additional detail has been presented in Table 1a to clarify whether the tonnage is nickel content or the weight of material shipped. The most significant nickel exports from Canada are nickel oxide sinter exports to the United Kingdom, nickel in matte exports to Norway, and unwrought nickel exports (of which over half went to the United States). The most significant nickel import was mixed nickel-cobalt feed for Sherritt International Corporation's refinery in Alberta. About 10 000 t of nickel intermediates were also imported in 2001. The data for nickel in concentrates exported from Australia to Canada in 2000 do not appear in the trade data and may have been misclassified under the tariff system as 7501.10 (nickel intermediates).

Table 1b provides an historical summary of nickel production and use from 1970 to date for selected years.

Additional trade information is also presented in Table 1c, which shows the total trade of cupro-nickel, nickel-silver, stainless steel, and nickel-containing batteries. These data do not show the weight of the contained nickel but, rather, the entire weight of the material; thus, stainless steel data show the weight of nickel plus iron plus chromium plus other alloying elements.

The increase in Canadian nickel production in 2001 was due to increased mine production in Ontario as production recovered in 2001 from the effects of the labour action at Falconbridge Limited's mines and smelter, which lasted from August 2000 to February 2001.

Canadian shipments of recoverable cobalt in concentrate from Canadian mines totaled 2047 t in 2001, almost equal to the 2022 t produced in 2000. Refined cobalt production was 4063 t in 2001, compared to 4091 t in 2000. Table 2a provides cobalt production and trade data for 1999 and 2000. Note that the unit of measurement for the data in Table 2a is kilograms.

Table 2b provides an historical summary of Canadian cobalt production and use from 1970 to 2000 for selected years.

CANADIAN DEVELOPMENTS

There were four nickel and cobalt producers in Canada in 2001, and there will be five such producers in 2002 as Canmine Resources Corporation started commissioning its hydrometallurgical refinery at the end of 2001. As noted earlier, Table 3 provides data on where to get additional information from the Internet for Canadian nickel-producing companies.

Table 4 provides summary details about Canadian nickel and cobalt production facilities in 2001. This table shows the type of output at each facility (e.g., nickel in concentrate is processed to nickel in matte, which is then processed to refined nickel, so counting all tonnages would triple-count production); therefore, the "production" data are not additive. For additional information about these facilities, readers can refer to the corporate web sites listed in Table 3, to the securities information available from the sources listed in Table 3, and to the "Nickel" chapter of the 2000 *Canadian Minerals Yearbook* <www.nrcan.gc.ca/mms/cmy/content/2000/42.pdf>, which presents a detailed review of Canada's nickel and cobalt production facilities in 2000.

Table 7 presents the capacities of nickel production facilities in Canada.

For more information about events during 2001, the reader may examine the 2001 *Nonferrous Metals Outlook*, prepared in October 2001, available at <www.nrcan.gc.ca/mms/pubs/nfo-e.htm>.

In addition, monthly Canadian nickel data are posted monthly at <http://mmsd1.mms.nrcan.gc.ca/mmsd/data/default_e.asp>. At this site, data are available in three file formats. Table 7 in all the files listed at the web site shows data by month for:

- mine output (nickel content in concentrates produced);
- primary production (recoverable nickel in concentrates shipped);
- refined production (includes nickel in chemicals and in Class II forms); and
- domestic shipments of refined production.

WORLD NICKEL PRODUCTION

Table 5 shows a list of world nickel producers and their web sites, where available. Table 6 provides information about world nickel producers for 2001.

Tables 8 and 9 show, respectively, selected mine production and primary production data for nickel.

WORLD COBALT PRODUCTION

World cobalt mine and metal production data by country from the International Consultative Group on Nonferrous Metals Statistics for the period 1991 to 2000 were presented in Figures 3 and 4 of the Nickel chapter in the 2000 *Canadian Minerals Yearbook* <www.nrcan.gc.ca/mms/cmy/content/42.pdf>. Table 9 presents CDI information about cobalt availability by company for the period 1996 to 2001.

NICKEL USE

The important world markets for primary nickel are shown in Figure 3. In addition to the 1.1 Mt of primary nickel used in 2001, there were approximately 600 000 t of nickel contained in stainless steel scrap used by stainless steel mills in 2001.

The stainless steel industry is the largest user of nickel, both in the primary and recycled forms. According to Macquarie Equities Limited, stainless steel production declined by almost 4% to 17.9 Mt from 18.6 Mt in 2000.

COBALT USE

Information about cobalt uses can be obtained from Canmine's Internet site at <www.canmine.com/me/index.html> (click on "cobalt market"), The Cobalt Development Institute's Internet site at <www.thecdi.com> (click on "about cobalt"), the U.S. Geological Survey's Internet site at <http://minerals.usgs.gov/minerals/pubs/commodity/cobalt>, and the OM Group Inc.'s Internet site at <www.omgi.com>.

At the OM Group site, click on the button marked "select a category"; this leads the viewer to a series of application titles. Each title can be clicked on for more information about the specific application.

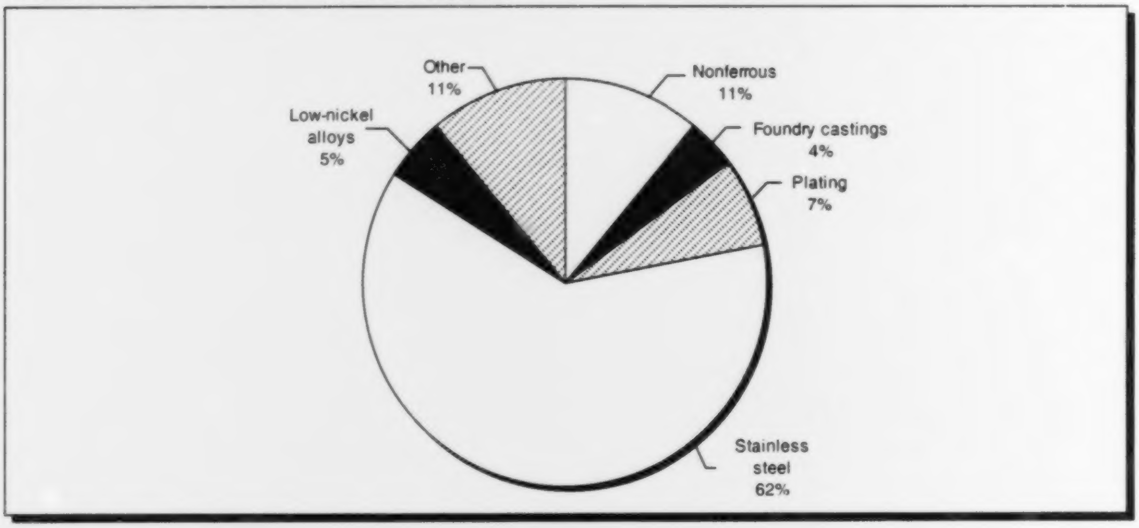
Canadian cobalt use is reported in Table 2B.

RECYCLING, HEALTH AND THE ENVIRONMENT

Health and environmental issues relating to nickel are examined briefly in a general fact sheet on nickel (<www.nrcan.gc.ca/mms/cmy/mfs_e.htm>).

To calculate a recycling rate, one needs to know the product life for the materials used in goods. Stainless steel is used in relatively long-life applications due to its higher initial cost and lower maintenance costs over its years in service. So this means that there is a long period of time between the production of the nickel-containing stainless steel and its recycling. But, during that time, demand and production

Figure 3
Western World Plus China Nickel Use, 2001



Source: Inco Limited's 10K report, 2001.
Notes: Western World excludes the Russian Federation, Cuba, the former Eastern Europe and the C.I.S. About 78% of stainless steel is estimated to be nickel-containing.

grow. At a 6% growth rate, stainless steel demand more than quadruples in 25 years. If all the nickel in stainless steels produced in one year were to be recycled after 25 years, the recycling of 100% of that material would only represent 25% of the nickel being used to make stainless steel. Therefore, in this case, 100% recycling would translate into a feed ratio of only 25% recycled material if all scrap were sourced only from used consumer and industrial goods (i.e., "old" scrap). Thus, one can conclude that recycling rates are higher than the ratio of recycled feed to total feed; calculating the true recycling rate is difficult because of the varying product lives that contain nickel.

PRICES AND INVENTORIES

Figure 2 shows prices in 2001 and for the period 1986 to 2001. Inventories on the London Metal Exchange (LME) rose from 9624 t at the start of the year to 19 188 t at year-end. This rise took inventories to only 40% of the level at the start of 2000, which was 46 908 t.

Current and historical nickel prices and inventories are available on the LME's Internet site at <www.lme.co.uk>. Another site for nickel prices is <www.metalalloys.com>.

Cobalt

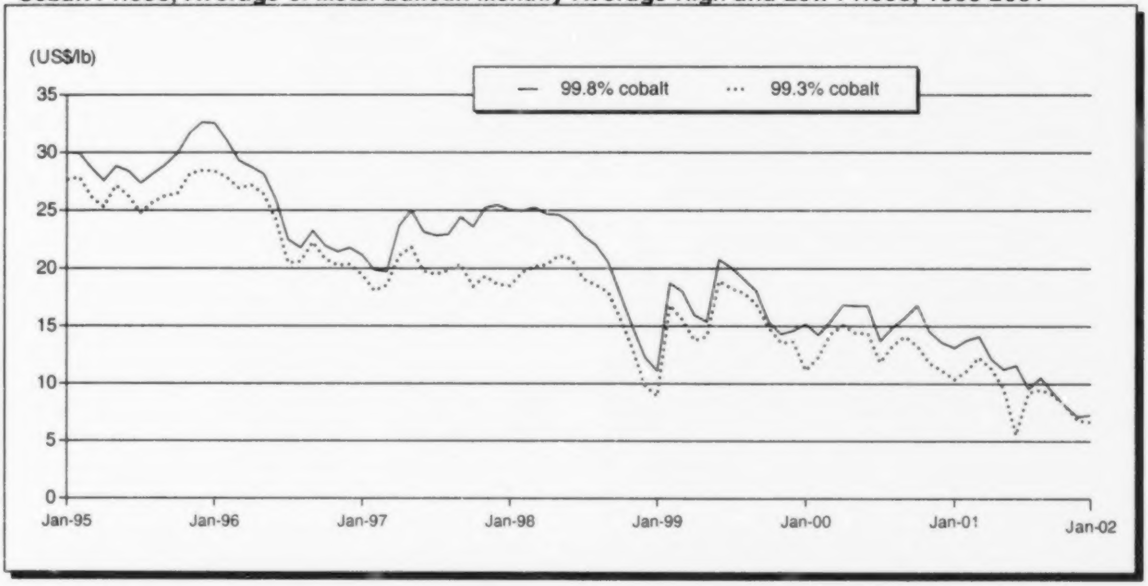
Cobalt prices on a monthly basis are shown in Figure 4. No terminal markets such as the LME exist for cobalt, although WMC Limited reports trading on its Internet site at <www.wmc.com> and, more recently, OMG on its site at <www.omgcobalt.com> .

OUTLOOK

The outlook for nickel demand is a function of the industrial activity of the major countries in the world. The largest user of nickel, both primary and recycled, is the stainless steel industry, whose use is strongly correlated with indices of industrial production (see the "Nickel" chapter of the 1999 *Canadian Minerals Yearbook*, Figure 5, for a graph illustrating the relationship).

The demand for primary nickel is expected to grow at an average trend rate of 3%/y or less during the next decade. The actual demand in any year will vary about the trend due primarily to changes in world industrial activity, which cause changes in stainless steel demand. It is suggested that high growth rates for austenitic[1] stainless steel would increase nickel

Figure 4
Cobalt Prices, Average of Metal Bulletin Monthly Average High and Low Prices, 1995-2001



Source: *Metal Bulletin.*

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[1] Type of stainless steel containing nickel; ferritic stainless steels do not contain nickel.

prices; a sustained period of prices in the US$8500/t range would decrease the competitiveness of a significant portion of austenitic stainless steel production. Unless new lower-cost production came on stream, the higher nickel prices would lead to decreased demand growth for nickel.

The December 1998-November 2001 price cycle that peaked in March 2000 at US$10 660/t did not result in new nickel production capacity building following this peak as had occurred when prices improved in earlier price cycles. Part of the reason for the lack of enthusiasm by potential new entrants to the nickel industry in times of high prices was due to the legacy of the laterite debts. Lenders and bond holders for two Australian projects, Cawse and Bulong, were disappointed at the inabilty of these projects to service debt. At the end of 2001, Anaconda Nickel Limited, operator of the third Australian project, reported a loss of A$458 million, largely due to writeoffs.

The traditional producers continued with incremental capacity increases at existing operations (e.g., Sherritt at Moa Bay and Fort Saskatchewan) to reduce operating costs. Some new production capacity came on stream in 2001, such as BHP Billiton's doubling of the capacity of its FeNi plant in Colombia and Anglo American plc's Loma de Niquel new 20 000-t/y operation in Venezuela. In contrast, there was no announcement of a decision on whether to expand Nkomati, as had been expected, and BHP Billiton's Ravensthorpe investment was delayed while studies continued. Inco Limited announced its commitment to the 54 000-t/y Goro project in New Caledonia; the US$1.4 billion operation is scheduled to start producing in 2004. In part, the go-ahead was attributable to the favourable tax concessions that Inco secured in New Caledonia, giving Inco's Goro project a 100% tax holiday for 15 years followed by a 50% tax holiday for 5 years. In addition, Inco will also benefit from financing assistance from the French government.

In general, the amount of new production capacity scheduled to come on stream in the next five years is regarded as insufficient to meet the expected growth rate in stainless steel production. This implies that the growth in stainless steel production will not be as high as expected with higher nickel prices retarding stainless demand. Higher stainless steel prices due to higher nickel prices will act to moderate the stainless steel demand growth rate.

Nickel price volatility is expected to continue with price levels dependent upon world economic activity. For that reason, a series of annual prices by year is not forecasted here, but it is suggested the probable average annual prices will fall over the next 15 years and will be within a range of US$8800-$4400/t (US$4-$2/lb) with the caveat that successes of new technologies and building new laterite capacity should result in the lower price boundary of the forecast range declining over time, to perhaps US$3310/t (US$1.50/lb). But, in the next three to five years, annual nickel prices are expected to remain in the upper portion of the forecast range. For shorter intervals, nickel prices may be much higher.

The prices noted above are current prices, not inflation-adjusted prices, assuming that the U.S. currency maintains its current strength relative to other major currencies. However, it seems increasingly likely that the U.S. currency value will decline relative to other major currencies, so the nominal price in U.S. dollars may increase more than the price in Euros, as an example. If the Canadian dollar appreciates relative to the U.S. dollar, this will pose a challenge to Canadian producers who have many of their costs denominated in Canadian currency. Nickel prices are not expected to vary with the rates of inflation expected; technological advances are expected to more than overcome inflationary pressures. In fact, if stainless steels and other nickel-containing products are to grow at high compound rates, then nickel prices will need to continue to drop faster than the rate of inflation to allow stainless steel and other nickel-containing products to penetrate new markets.

Cobalt

Cobalt prices (Figure 4) continued their downward trend, due less to increasing nickel production from nickel-cobalt deposits in 2001 than to the downturn in aerospace demand following the terrorist attack in the United States. The expectation is that decisions to proceed with a number of new hydrometallurgical nickel-cobalt laterite plants would further depress cobalt prices in the medium term. However, a lower price would allow cobalt to be used economically in other applications for which it is presently too expensive. The high prices of the mid-1990s would be very difficult to sustain in the future, given present conditions and expectations.

ADDITIONAL SOURCES OF INFORMATION

Readers may access various additional sources of information on the Internet to obtain more details about nickel in general. A search engine, such as Google <www.google.com/advanced_search> is a good way to start to find such information. A few sites for additional information include:

Natural Resources Canada
Canadian Minerals Yearbook:
<www.nrcan.gc.ca/mms/cmy/pref_e.html>
Metal and mineral statistics:
<http://mmsd1.mms.nrcan.gc.ca/mmsd/minstatistics_e.asp>

Nickel production by month:
<http://mmsd1.mms.nrcan.gc.ca/mmsd/data/default_e.asp>
Production by province and territory:
<http://mmsd1.mms.nrcan.gc.ca/mmsd/production/production_e.asp>

Physical/Chemical Properties of Nickel
<www.webelements.com/webelements/elements/text/Ni/key.html>

Physical/Chemical Properties of Cobalt
<www.webelements.com/webelements/elements/text/Co/key.html>

WMC Market News and Commentary
<www.wmc-nickel.com/news.asp>
The site provides market information and industry developments (hundreds of items of market information for 1999 onward).

International Nickel Study Group
<www.insg.org>

U.S. Geological Survey
Comprehensive commodity reviews:
<http://minerals.usgs.gov/minerals/pubs/commodity>

Yahoo Search of Mining News
<http://biz.yahoo.com/news/mining.html>
(Scroll to the bottom of the page and put the word "nickel" into "Search News.")

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of June 30, 2002. (3) Various Internet sites have been identified in this article. Please note that Natural Resources Canada has no control over the content of the web sites of other organizations, which may be modified, updated or deleted at any time. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TARIFFS

		Canada			United States	EU	Japan (1)	Brazil	India	Taiwan	Korea (2)
Item No.	Description	MFN	GPT	USA	Canada	MFN	WTO	MFN	MFN	MFN	MFN
2604.00	Nickel ores and concentrates	Free	Free	Free	Free	Free	Free	4.50%	5%	Free	1%
2825.40	Nickel oxides and hydroxides	Free	Free	Free	Free	Free	4.80%	4.5-12.5%	35%	2.50%	8%
7202.60	Ferro-nickel	6.50%	Free	Free	Free	Free	3.30%	8.50%	25%	Free	3%
7501.10	Nickel mattes	Free	Free	Free	Free	Free	Free	8.50%	15%	Free	1%
7501.20	Nickel oxide sinters and other intermediate products of nickel metallurgy	Free	Free	Free	Free	Free	Free-44 yen/kg (3)	8.50%	15%	Free	1-2%
7502.10	Unwrought nickel, not alloyed	Free	Free	Free	Free	Free	44 yen/kg	8.50%	15%	1.25%	3%
7502.20	Unwrought nickel alloys	Free	Free	Free	Free	Free	Free-3% (4)	8.50%	15%	1.25%	3%
7503.00	Nickel waste and scrap	Free	Free	Free	Free	Free	Free	4.50%	15%	Free	1%
7504.00	Nickel powders and flakes	Free	Free	Free	Free	Free	Free-41 yen/kg-3%	8.50%	15%	Free	5%
7505.11	Bars, rods and profiles of nickel, not alloyed	Free	Free	Free	Free	Free	3%	14.50%	15%	2.50%	5%
7505.12	Bars, rods and profiles of nickel alloys	Free	Free	Free	Free	2.90%	3%	14.50%	15%	2.50%	5%
7505.21	Nickel wire, not alloyed	Free	Free	Free	Free	Free	3%	14.50%	15%	1.25%	5%
7505.22	Wire of nickel alloys	Free	Free	Free	Free	2.90%	3%	14.50%	15%	1.25%	5%
7506.00	Nickel plates, sheets, strip and foil	Free	Free	Free	Free	Free-3.3%	Free-3%	14.50%	15%	2.50%	5%
7507.00	Nickel tubes, pipes, and tube or pipe fittings	Free	Free	Free	Free	Free-2.5%	Free-3%	16.50%	15%	2.50%	8%
7508.00	Other articles of nickel	Free-3%	Free	Free	Free	Free	3%	18.50%	15%	1.25-5%	8%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (41st Annual Edition: 2001); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Brazil* (8th Annual Edition: 2001); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of India* (8th Annual Edition: 2001); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Korea* (8th Annual Edition: 2001); *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of Taiwan* (6th Annual Edition: 2001); *Customs Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).

(1) WTO rate is shown; lower tariff rates may apply circumstantially. (2) South Korea. (3) Free except for nickel oxide sinters containing by weight not less than 88% nickel, for which the tariff rate is 44 yen/kg, and nickel oxide containing by weight not more than 1.5% copper, for which the tariff rate is 3%. (4) The tariff rate of 3% applies to nickel alloys other than those containing by weight less than 50% nickel and not less than 10% cobalt.

TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2605.00	Cobalt ores and concentrates	Free	Free	Free	Free
2822.00	Cobalt oxides and hydroxides, commercial cobalt oxides	Free	Free	Free	Free
2827.34	Cobalt chloride	4%	3%	Free	Free
2833.29.00.40	Cobalt sulphate	Free	Free	Free	Free
2836.99.10.30	Cobalt carbonates for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics; cobalt carbonates to be employed as drilling mud or additives in drilling for minerals, natural gas, oil or water	Free	Free	Free	Free
2836.99.90.20	Other cobalt carbonates	3.50%	3%	Free	Free
2915.23.10	Cobalt acetates for use as petroleum refining catalysts, or for use in the manufacture of animal or poultry feeds, glues or adhesives, optical fibres or optical fibre bundles or cables, typewriter or similar ribbons, polymers in primary forms or profile shapes or sheets of plastics	Free	Free	Free	Free
2915.23.90	Other cobalt acetates	6.50%	3%	Free	Free
8105.10	Cobalt mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; waste and scrap; powders				
8105.10.10	Cobalt waste and scrap fit only for remelting and recovery of the metal content; powders; unwrought cobalt, not alloyed	Free	Free	Free	Free
8105.10.90	Other	3%	Free	Free	Free
8105.90.10	Cobalt bars and rods, not alloyed	3%	Free	Free	Free
8105.90.90	Cobalt and articles thereof, n.e.s.	3%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.
n.e.s. Not elsewhere specified.

TABLE 1a. CANADA, NICKEL PRODUCTION AND TRADE, 2000 -2001

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
MINE OUTPUT	Nickel content of concentrate	190 793	..	193 361	..
PRODUCTION	Recoverable nickel content in concentrates shipped in 2001				
	All forms				
	Quebec	22 946	294 369	24 199	232 359
	Ontario	114 415	1 467 824	116 418	1 117 849
	Manitoba	43 778	561 634	43 026	413 132
	Total Canada	181 139	2 323 827	183 643	1 763 340
	Finished nickel output (refined nickel in various shapes in Class 1, plus Class II nickel (as defined by the International Nickel Study Group), which includes nickel oxide sinter	134 225	..	140 591	..
EXPORTS					
2604.00.40	Nickel ores and concentrates (nickel content)				
	United States	–	–	6	39
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Hong Kong	954	10 622	409	4 573
	United States	75	1 052	120	1 134
	China	9	125	91	969
	Singapore	71	968	60	615
	Sweden	–	–	149	527
	Japan	–	–	11	128
	Malaysia	85	1 054	8	77
	Brazil	6	117	2	43
	Germany	–	–	2	25
	France	–	–	1	10
	United Kingdom	18	51	–	–
	Total	1 218	13 989	853	8 101
2827.35	Nickel chlorides (weight of material, not nickel content)	–	–	–	–
2833.24	Nickel sulphates (weight of material, not nickel content)				
	United Kingdom	332	1 752	284	1 839
	United States	4	6	–	–
	South Africa	91	293	–	–
	Total	427	2 051	284	1 839
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	Belgium	–	–	19	100
	United States	28	157	138	62
	Argentina	–	–	–	–
	Total	28	157	157	162
7202.60	Ferronickel	–	–	–	–
7204.21	Stainless steel waste and scrap (weight of material, not nickel content)				
	Netherlands	–	–	–	–
	Spain	5 593	6 498	–	–
	United Arab Emirates	–	–	–	–
	Brazil	37	50	–	–
	Italy	46	56	–	–
	Switzerland	3	14	–	–
	United States	31 267	27 019	27 350	24 074
	China	189	185	1 372	1 400
	India	1 363	1 308	858	827
	Japan	182	258	392	404
	Taiwan	483	670	294	141
	South Korea	812	1 215	159	153
	United Kingdom	–	–	39	229
	Hong Kong	25	34	25	31
	Total	40 000	37 307	30 489	27 259
7501.10	Nickel mattes (nickel content)				
	Norway	41 031	572 078	45 199	632 275
	Netherlands	–	–	3 182	31 336
	India	21	105	–	–
	Total	41 052	572 183	48 381	663 611

TABLE 1a (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7501.20	Nickel oxide sinters and other intermediate products of nickel metallury (weight of material, not nickel content)				
	United Kingdom	40 290	387 512	38 061	284 775
	South Korea	1 105	9 217	2 649	17 325
	United States	3 225	39 714	1 621	15 556
	Taiwan	1 434	11 530	1 292	8 447
	Belgium	936	8 913	500	3 757
	Total	46 990	456 886	44 123	329 860
7502.10	Nickel unwrought, not allowyed (nickel content)				
	United States	52 132	662 659	50 716	528 980
	Belgium	10 295	135 500	10 482	99 989
	Hong Kong	6 511	88 106	8 410	89 666
	Netherlands	3 844	48 167	7 954	72 285
	Taiwan	3 761	51 800	5 806	57 032
	Italy	6 382	82 225	5 038	49 049
	United Kingdom	2 340	29 384	3 909	38 581
	Singapore	2 287	30 795	3 816	33 125
	Japan	2 973	39 457	2 158	21 057
	China	525	6 652	1 614	14 714
	Thailand	853	11 389	1 231	11 183
	France	1 386	17 617	1 104	9 928
	Australia	731	9 421	750	7 661
	South Korea	221	3 119	844	7 552
	Indonesia	120	1 825	150	1 649
	Switzerland	–	–	145	1 412
	Spain	546	7 082	120	998
	Chile	96	1 420	72	830
	Philippines	79	1 172	72	800
	Turkey	–	–	36	409
	Brazil	17	176	23	240
	Luxembourg	...	–	24	195
	Venezuela	10	156	10	126
	Germany	–	–	...	25
	Argentina	7	94	–	–
	Total	95 116	1 228 216	104 484	1 045 486
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	Hong Kong	1 891	25 871	3 692	38 075
	Belgium	679	7 993	1 332	13 163
	South Korea	700	9 422	807	8 561
	China	284	3 623	747	7 834
	United States	217	3 034	39	460
	United Kingdom	–	–	4	28
	Netherlands	121	1 951	–	–
	Total	3 892	51 894	6 621	68 121
7503.00	Nickel waste and scrap (weight of material, not nickel content)				
	United States	5 100	34 103	2 628	10 787
	United Kingdom	11	55	69	277
	Netherlands	–	–	120	130
	Japan	521	3 675	19	62
	Germany	2	13	...	2
	Italy	23	29	–	–
	Total	5 657	37 875	2 836	11 258
7504.00	Nickel powders and flakes, alloyed and unalloyed (weight of material, not nickel content)				
	United States	6 470	109 649	4 515	75 419
	Japan	2 276	30 857	771	9 576
	United Kingdom	24	2 873	23	3 214
	Luxembourg	96	1 191	264	2 326
	South Korea	87	1 265	139	1 408
	Taiwan	111	1 982	126	1 238
	Germany	4	103	46	810
	Netherlands	250	3 519	60	551
	Sweden	–	–	42	467
	Belgium	30	609	18	248
	China	–	–	20	161
	France	24	353	12	138
	Thailand	1	121	5	128
	Austria	...	30	10	101
	Mexico	–	–	11	73
	South Africa	12	373	2	64
	Brazil	4	96	3	58
	Switzerland	2	46	2	28
	Ireland	1	16	1	19
	Hong Kong	...	20	...	18

TABLE 1a (cont'd)

Item No.		2000		2001	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
	Turkey	–	–	1	14
	Indonesia	...	21	1	12
	Czech Republic	–	–	1	11
	Argentina	5	10	...	3
	Spain	6	110	–	–
	Singapore	...	13	–	–
	Philippines	3	39	–	–
	New Zealand	...	28	–	–
	Cuba	...	14	–	–
	India	...	4	–	–
	Total	9 406	153 344	6 073	96 083
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)				
	United States	–	–	11	181
7505.12	Bars, rods and profiles of nickel alloy (weight of material, not nickel content)				
	Brazil	–	–	17	105
	United States	...	9	1	44
	Poland	1	13	1	6
	China	...	6	...	1
	United Kingdom	1	10	–	–
	Italy	1	8	–	–
	Russia	1	9	–	–
	Japan	...	3	–	–
	Cuba	...	7	–	–
	Total	4	65	19	156
7505.21	Nickel wire, not alloyed (weight of nickel wire plus coating if any, not nickel content)				
	United States	11	269	8	207
7505.22	Wire, nickel alloy (weight of alloy plus coating, if any; not nickel content)				
	United States	30	662	22	493
	Sweden	–	–	19	137
	United Kingdom	3	42	–	–
	Germany	2	40	–	–
	Taiwan	20	148	–	–
	Total	55	892	41	630
7506.00 (a)	Nickel plates, sheets, strip and foil (weight of material, not nickel content)				
	United States	3	44	16	676
	Poland	1	17	12	147
	China	...	2	1	15
	South Korea	–	–	...	3
	Libyan Arab Jamahiriya	1	2	–	–
	Italy	...	1	–	–
	Russia	...	2	–	–
	Total	5	68	29	841
7507.00 (b)	Tubes, pipes and tube or pipe fittings alloyed and unalloyed (weight of material, not nickel content)				
	United States	..	3 294	..	2 864
	Brazil	–	–	..	647
	United Arab Emirates	..	21	..	344
	Japan	..	70	..	267
	Singapore	..	23	..	91
	Australia	..	15	..	18
	Germany	..	159	..	7
	Malaysia	–	–	..	7
	New Zealand	–	–	..	3
	Poland	..	36	–	–
	Netherlands	..	78	–	–
	Russia	..	40	–	–
	China	..	45	–	–
	Mexico	..	7	–	–
	Total	..	3 788	..	4 248

TABLE 1a (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7508.00	Other articles of nickel (weight of material, not nickel content)				
	United States	..	10 236	..	11 933
	Poland	..	96	..	179
	United Kingdom	..	30	..	152
	China	..	337	..	147
	Germany	..	100	..	104
	France	..	39	..	62
	New Zealand	–	–	..	60
	Italy	..	10	..	38
	Singapore	..	7	..	32
	Australia	..	12	..	22
	Hong Kong	–	–	..	14
	South Korea	–	–	..	9
	Cuba	–	–	..	7
	Sweden	..	54	..	6
	Netherlands	..	5	..	5
	Switzerland	–	–	..	2
	Finland	..	...	..	...
	Czech Republic	..	6	..	...
	Japan	..	34	–	–
	Brazil	..	...	–	–
	Norway	..	...	–	–
	Russia	..	6	–	–
	Ethiopia	..	1	–	–
	French Polynesia	..	1	–	–
	Mexico	..	...	–	–
	Total	..	10 974	..	12 772
	Total exports	..	2 569 978	..	2 270 855
IMPORTS					
2604.00.00.20	Nickel ores and concentrates (nickel content)				
	Australia (1)	–	–	1 003	9 216
	United States	1 146	7 207	938	5 929
	Finland	–	–	–	–
	Germany	5	46	–	–
	Tanzania, United Republic of	...	...	–	–
	Dominican Republic	...	1	–	–
	Total	1 151	7 254	1 941	15 145
2620.90	Ash and residue that is known to contain nickel (weight of material, not nickel content; material also includes significant cobalt)				
	Cuba (2,3)	54 865	361 717	62 418	303 997
2825.40	Nickel oxides and hydroxides (weight of material, not nickel content)				
	Finland	365	5 409	498	7 036
	United States	3 119	1 174	3 126	1 254
	Germany	236	137	–	–
	United Kingdom	...	...	–	–
	Belgium	2	2	–	–
	Total	3 722	6 722	3 624	8 290
2827.35	Nickel chlorides (weight of material, not nickel content				
	United States	116	736	77	502
	France	146	626	63	350
	United Kingdom	...	1	...	...
	Germany	...	...	...	...
	Switzerland	–	–	...	...
	Norway	...	...	–	–
	Total	262	1 363	140	852
2833.24	Nickel sulphates (weight of material, not nickel content)				
	United States	544	4 173	1 610	5 228
	Finland	256	735	204	555
	Belgium	203	697	102	294
	Austria	10	38	6	18
	France	7	24	3	9
	Australia	120	1 661	2	6
	South Africa	31	117	...	1
	Japan	...	1	–	–
	Taiwan	...	1	–	–
	Total	1 171	7 447	1 927	6 111

TABLE 1a (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
3815.11	Catalysts and other reaction initiators, reaction accelerators and catalytic preparations with nickel or nickel compounds as the substance (weight of material, not nickel content)				
	United States	1 062	14 645	488	5 507
	Germany	176	2 182	237	2 799
	United Kingdom	173	3 467	191	2 562
	Denmark	3	60	61	1 878
	Belgium	18	369	8	186
	India	1	6	14	116
	Netherlands	8	121	6	90
	France	...	1	...	7
	Switzerland	–	–	...	...
	Japan	2	28	–	–
	Netherlands Antilles	10	148	–	–
	South Africa	31	1 112	–	–
	Total	1 482	22 139	1 005	13 145
7202.60	Ferronickel (weight of material, not nickel content)				
	United States	54	289	65	339
7204.21	Stainless steel scrap (weight of material, not nickel content)				
	United States	46 701	44 108	35 717	29 404
	China	395	405	238	259
	Canada	39	42	1	1
	Belgium	7	9	–	–
	Greece	..	...	–	–
	Liberia	16	14	–	–
	India	1	1	–	–
	Brazil	15	14	–	–
	Total	47 174	44 593	35 956	29 664
7501.00 (c)	Nickel mattes (nickel content), nickel oxide sinters and other intermediate products of nickel metallurgy (weight of material, not nickel content)				
	Australia	5 234	30 520	4 634	26 187
	Belgium	515	1 265	353	453
	Chile	–	–	32	79
	China	60	404	–	–
	Cuba	–	–	...	...
	Germany	1 198	1 697	982	1 041
	Japan	...	...	1	7
	Netherlands	36	361	–	–
	New Caledonia	–	–	...	...
	Russia	82	475	34	40
	South Africa	186	1 116	1 564	5 997
	Switzerland	112	424	–	–
	Taiwan	–	–	...	1
	United Kingdom	269	1 320	2	16
	United States	2 363	6 791	2 297	6 112
	Total	10 055	44 382	9 899	39 933
7502.10	Nickel unwrought, not alloyed (nickel content)				
	Norway	1 159	13 689	1 029	9 846
	Finland	243	3 424	171	1 913
	United States	351	4 373	56	655
	Russia	87	782	65	618
	China	–	–	25	271
	United Kingdom	124	1 258	45	266
	Canada	81	1 054	22	220
	France	7	116	11	123
	South Africa	1	7	4	32
	Zimbabwe	9	157	1	5
	Germany	–	–	...	4
	Bermuda	38	210	–	–
	Netherlands	9	141	–	–
	Spain	19	265	–	–
	Taiwan	...	...	–	–
	Australia	...	3	–	–
	Total	...	25 479	1 429	13 953

TABLE 1a (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7502.20	Nickel unwrought, alloyed (weight of material, not nickel content)				
	Russia	–	–	900	5 235
	United States	339	2 395	170	1 701
	Germany	406	662	331	1 375
	United Kingdom	102	1 008	25	340
	Malaysia	–	–	104	198
	Belgium	–	–	...	5
	Italy	–	–	...	...
	Israel	–	–	...	...
	Bermuda	258	1 418	–	–
	Canada	...	5	–	–
	Norway	22	154	–	–
	Switzerland	...	...	–	–
	Japan	...	...	–	–
	Total	1 127	5 642	1 530	8 854
7503.00	Nickel waste and scrap (weight of material, not nickel content)				
	United States	17 926	48 612	21 246	46 487
	United Kingdom	354	1 413	626	4 605
	Russia	1 014	5 617	89	502
	South Africa	–	–	60	495
	Norway	58	662	38	374
	Germany	601	1 871	110	224
	Canada	113	428	25	70
	Argentina	87	545	14	60
	Netherlands	42	348	–	–
	Bermuda	80	455	–	–
	Belgium	...	...	–	–
	Spain	9	18	–	–
	Switzerland	60	173	–	–
	Brazil	2	12	–	–
	Venezuela	156	991	–	–
	Mexico	22	13	–	–
	Total	20 524	61 174	22 208	52 817
7504.00	Nickel powders and flakes, alloyed and unalloyed (weight of material, not nickel content)				
	Australia	1 074	13 558	1 323	12 831
	United States	460	5 138	261	4 203
	Germany	296	1 779	227	2 787
	Belgium	159	1 894	104	1 222
	Ireland	–	–	18	394
	United Kingdom	23	222	20	291
	Switzerland	44	704	8	184
	Russia	22	257	11	125
	Japan	...	2	3	75
	South Korea	–	–	7	75
	Sweden	1	19	...	12
	Austria	1	7	1	9
	Canada	1	13	1	7
	Denmark	–	–	1	6
	Italy	–	–	...	1
	Finland	25	283	–	–
	South Africa	4	53	–	–
	China	2	52	–	–
	Hong Kong	3	22	–	–
	Total	2 115	24 003	1 985	22 222
7505.11	Bars, rods and profiles of nickel, not alloyed (nickel content)				
	United States	10	166	11	194
	Germany	...	8	...	8
	Canada	–	–	...	1
	United Kingdom	–	–	...	1
	Taiwan	–	–	...	...
	Italy	...	1	–	–
	Total	10	175	11	204

TABLE 1a (cont'd)

Item No.		2000		2001(p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7505.12	Bars, rods and profiles of nickel alloy (weight of material, not nickel content)				
	United States	977	20 220	936	19 971
	Italy	4	73	17	363
	Germany	84	1 462	19	286
	United Kingdom	4	79	6	110
	Canada	–	–	3	46
	Cayman Islands	–	–	1	29
	France	. . .	9	. . .	9
	Netherlands	. . .	2	. . .	6
	Argentina	. . .	2	1	6
	Austria	. . .	2	. . .	1
	Japan	. . .	1	. . .	1
	Taiwan	. . .	. . .	. . .	1
	Brazil	. . .	2	. . .	. . .
	Mexico	. . .	. . .	–	–
	Slovenia	1	3	–	–
	Total	1 070	21 855	983	20 829
7505.21	Nickel wire, not alloyed (weight of nickel wire plus coating if any, not nickel content)				
	United States	79	859	41	483
	Germany	19	240	10	178
	Japan	15	121	11	93
	Sweden	2	17	4	48
	Switzerland	. . .	. . .	. . .	5
	China	–	–	. . .	4
	Canada	–	–	. . .	3
	United Kingdom	–	–	. . .	. . .
	South Korea	3	33	–	–
	Total	118	1 270	66	814
7505.22	Wire, nickel alloy (weight of alloy plus coating, if any; not nickel content)				
	United States	350	6 770	314	6 708
	Germany	115	2 027	70	1 195
	Sweden	6	128	32	623
	United Kingdom	38	387	70	525
	France	89	1 272	36	495
	Austria	–	–	26	373
	Belgium	–	–	15	211
	Australia	–	–	4	52
	Italy	4	74	3	50
	South Korea	–	–	4	26
	Mexico	. . .	2	. . .	4
	Swaziland	–	–	. . .	2
	Taiwan	. . .	. . .	. . .	1
	Switzerland	. . .	3	. . .	. . .
	Japan	. . .	2	. . .	. . .
	Hong Kong	–	–	. . .	. . .
	Canada	. . .	. . .	–	–
	China	. . .	. . .	–	–
	Netherlands	. . .	. . .	–	–
	South Africa	1	14	–	–
	Total	603	10 679	574	10 265
7506.00	Nickel plates, sheets, strip and foil (weight of material, not nickel content)				
	United States	624	12 951	434	10 493
	Germany	1 111	22 148	150	2 632
	Japan	15	333	8	160
	United Kingdom	28	521	4	88
	France	1	12	1	42
	Sweden	2	33	1	21
	Italy	. . .	1	. . .	13
	Belgium	1	19	. . .	7
	Israel	–	–	. . .	4
	Finland	. . .	1	. . .	3
	Canada	. . .	9	. . .	1
	India	1	14	–	–
	Spain	. . .	. . .	–	–
	Poland	. . .	5	–	–
	South Korea	2	15	–	–
	Taiwan	. . .	5	–	–
	Total	1 785	36 067	598	13 464

TABLE 1a (cont'd)

Item No		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS (cont'd)					
7507.00	Tubes, pipes and tube or pipe fittings alloyed and unalloyed (weight of material, not nickel content)				
	Japan	633	21 452	761	37 546
	United States	593	12 934	770	15 931
	France	10	232	53	1 996
	Germany	26	555	57	1 349
	Norway	200	2 797	121	1 123
	United Kingdom	200	3 832	56	1 119
	Russia	–	–	38	300
	Brazil	–	–	17	293
	Italy	11	200	8	218
	Maxico	–	–	9	85
	Sweden	4	73	3	55
	Spain	. . .	3	1	22
	Taiwan	. . .	. . .	1	11
	China	. . .	. . .	2	10
	Austria	. . .	4	. . .	4
	Hong Kong	. . .	2	. . .	4
	Canada	. . .	5	. . .	3
	India	1	10	–	–
	Thailand	. . .	3	–	–
	Australia	. . .	1	–	–
	Total	1 678	42 103	1 917	60 069
7508.00	Other articles of nickel (weight of material, not nickel content)				
	United States	859	12 437	736	12 869
	France	311	1 613	353	1 372
	United Kingdom	42	701	37	703
	China	37	285	65	484
	Taiwan	12	123	32	384
	Canada	7	88	32	311
	Switzerland	5	34	30	254
	Israel	15	422	9	196
	Italy	4	79	7	129
	Germany	4	50	4	45
	India	3	47	2	41
	Japan	. . .	3	4	23
	Hong Kong	2	11	2	21
	Norway	–	–	2	19
	Korea, South	1	16	2	14
	Australia	–	–	1	10
	Poland	. . .	5	1	10
	Netherlands	1	10	1	9
	Indonesia	–	–	3	6
	Malaysia	. . .	. . .	. . .	6
	Mexico	. . .	4	. . .	5
	Greece	. . .	. . .	. . .	4
	Austria	1	4	1	3
	Thailand	. . .	. . .	. . .	2
	Spain	1	25	. . .	. . .
	Pakistan	–	–	. . .	. . .
	Russia	. . .	4	–	–
	Belgium	. . .	. . .	–	–
	Total	1 305	16 141	1 333	16 920
	Total imports		740 494		637 687
	Total exports	. . .	2 569 978	. . .	2 270 855
	Net exports of nickel		1 829 484		1 632 968

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available or not applicable; . . . Amount too small to be expresssed; (p) Preliminary.
(a) Included in the data are HS Codes 7506.10 and 7506.20. (b) Included in the data are HS Codes 7507.11, 7507.12 and 7507.20.
(c) Included in the data are HS Codes 7501.10 and 7501.20.
(1) While no imports from Australia were recorded in 2000, Jubilee Mines NL recorded at least two shipments of nickel in concentrates to Canada in 2000; an investigation into these shipments has not been completed. (2) Nickel and cobalt are in the artificial nickel-cobalt sulphide made at an acid leach plant in Cuba using nickel-cobalt oxides as feed. The values reflect both the nickel and the cobalt contents. (3) The tonnage and value of nickel in residue returned to Canada after processing nickel oxides in the United Kingdom cannot be separated out from tonnages of other residues imported from the United Kingdom and so is not included in this total.
Note: Numbers may not add to totals due to rounding.

TABLE 1b. CANADA, NICKEL PRODUCTION AND USE, 1970, 1975, 1980 AND 1985-2001

	Production (1) (Mine Output)	Use (2)
	(tonnes)	
1970	277 490	10 699
1975	242 180	11 308
1980	184 802	9 676
1985	169 971	7 206
1986	163 640	8 865
1987	193 391	9 732
1988	216 589	9 250
1989	200 899	10 421
1990	196 225	8 410
1991	192 259	(a) 13 322
1992	186 384	15 528
1993	188 080	(a) 17 384
1994	149 886	20 746
1995	181 820	20 973
1996	192 649	24 504
1997	(r) 190 502	19 447
1998	(r) 208 301	19 787
1999	(r) 186 236	22 527
2000	190 793	24 976
2001 (p)	193 361	. .

Source: Natural Resources Canada.
. . Not available; (p) Preliminary; (r) Revised.
(a) Increase in number of companies being surveyed.
(1) Refined nickel and nickel in oxides and salts produced, plus recoverable nickel in matte and concentrates exported. Data for 1987-2001 are nickel contained in concentrates produced.
(2) Use of metallic nickel, all forms (refined metal, nickel in ferronickel oxides and salts, and other forms of nickel including nickel in purchased scrap) as reported by users on the Natural Resources Canada survey "Nickel Used."
Note: Metals are used in industrial and consumer applications; unlike fuel oil or agricultural commodities, metals are not "used up" or "consumed"; instead, they are recycled. Discussions taking place in international fora indicate that the term "consumption" should be changed to more appropriately reflect actual practice. For this reason, the word "use" has replaced "comsumption" in this chapter, where appropriate.

TABLE 1c. CUPRONICKEL, NICKEL-SILVER, STAINLESS STEELS, AND NICKEL-CADMIUM AND NICKEL-IRON BATTERIES, 2000 AND 2001

	2000		2001	
	(tonnes)	($000)	(tonnes)	($000)
STAINLESS STEEL SEMI-FABRICATED ITEMS (excludes scrap)				
Exports – Total For Each HS Class				
7204.29	163 052	33 192	104 207	20 582
7210.90	2 629	4 291	4 988	7 392
7220.20	3 067	11 852	3 871	12 694
7222.11	6 077	12 996	6 686	15 595
7222.19	440	1 802	238	1 032
7222.20	13 207	59 466	11 502	57 483
7222.30	269	1 298	1 568	6 844
Total exports	188 741	124 897	133 060	121 622
Imports – Total For Each HS Class				
7204.29	203 385	59 293	163 929	53 307
7210.90	6 660	14 410	5 018	11 224
7212.50.90.13	3 078	7 187	3 336	8 038
7222.11	2 168	8 701	2 504	10 160
7222.19	3 090	13 068	3 002	14 686
7222.20.10	40	213	154	890
7222.20.90	11 636	45 381	9 086	36 752
7222.30.00.11	282	1 815	202	1 324
7222.30.00.19	12	44	5	22
Total imports	230 351	150 112	187 236	136 403
Net exports of stainless steels	-41 610	-25 215	-54 176	-14 781
CUPRO-NICKEL AND NICKEL-SILVER SEMIFABRICATED GOODS (nickel-silver is a copper-nickel-zinc alloy)				
Exports – Total For Each HS Class				
7403.23	88	370	95	330
7407.22	140	1 301	150	1 067
7408.22	24	323	22	341
7409.40	5 257	70 802	1 899	9 823
7411.22	2 816	21 667	4 805	37 911
Total exports	8 325	94 463	6 971	49 472
Imports – Total For Each HS Class				
7403.23.00.10 to 7403.23.00.40	218	736	84	300
7407.22.11 to 7407.22.29.10	51	252	89	426
7408.22.10 to 7408.22.90.30	373	940	346	961
7409.40.00.11 to 7409.40.00.40	2 447	10 052	108	522
7411.22.00.10 to 7411.22.00.30	392	2 509	415	2 718
Total imports	3 481	14 489	1 042	4 927
Net exports of cupro-nickel and nickel-silver	4 844	79 974	5 929	44 545
ELECTRIC ACCUMULATORS (nickel-cadmium and nickel iron batteries)				
Exports – Total For Each HS Class				
Ni-Cd batteries 8507.30	. .	8 945	. .	7 916
Ni-Fe batteries 8507.40	. .	42	. .	158
Total exports	. .	8 987	. .	8 074
Imports – Total For Each HS Class				
Ni-Cd batteries 8507.30	. .	59 222	. .	44 304
Ni-Fe batteries 8507.40	. .	3 025	. .	840
Total imports	. .	62 247	. .	45 144
Net exports of Ni-Cd and Ni-Fe batteries	. .	-53 260	. .	-37 070

Source: Natural Resources Canada.
. . Not available.

TABLE 2a. CANADA, COBALT PRODUCTION AND TRADE, 2000 AND 2001, AND USE, 1999-2001

Item No.		2000		2001 (p)	
		(kilograms)	($000)	(kilograms)	($000)
MINE OUTPUT	Cobalt content of concentrates milled	5 298 164		5 333 691	
PRODUCTION	Recoverable cobalt in concentrates shipped				
	Quebec	229 371	11 384 141	251 000	9 580 912
	Ontario	1 359 539	67 476 640	1 401 355	53 491 122
	Manitoba	433 408	21 510 906	395 533	15 097 890
	Total	2 022 318	100 371 687	2 047 888	78 169 933
	Refined (1)	4 078 955		4 062 613	
EXPORTS					
2605.00	Cobalt ores and concentrates (cobalt content)	–	–	–	–
2822.00	Cobalt oxides and hydroxides; commercial cobalt oxides (weight of material, not cobalt content)				
	United Kingdom	327 651	10 457	355 512	10 305
	United States	1 364	83	–	–
	South Korea	5 480	115	–	–
	Taiwan	6	. . .	–	–
	Total	334 501	10 655	355 512	10 305
2915.23	Cobalt acetates (weight of material, not cobalt content)	–	–	–	–
8105.10	Cobalt, mattes and other intermediate products of cobalt metallurgy; unwrought cobalt; waste, scrap and powders (cobalt content of unwrought and mattes, and powders; weight of material for intermediate, alloys and waste and scrap)				
	Norway	1 569 862	62 380	1 437 154	49 377
	United States	864 884	37 638	839 747	34 220
	Japan	1 195 843	58 870	1 003 191	31 922
	Netherlands	464 600	23 175	693 836	22 938
	Belgium	289 978	13 676	410 038	20 104
	Singapore	304 000	14 879	302 400	8 973
	United Kingdom	114 809	3 850	95 562	3 880
	Australia	44 000	1 242	73 000	2 275
	Hong Kong	50 000	2 369	85 174	2 219
	South Korea	15 241	877	21 950	1 137
	China	20 000	1 035	20 000	643
	Germany	–	–	1 724	185
	India	21 716	967	857	47
	Portugal	–	–	500	22
	Argentina	1 100	50	500	14
	Taiwan	–	–	250	12
	Switzerland	–	–	32	2
	France	45	3	–	–
	Indonesia	1 949	125	–	–
	Mexico	311	20	–	–
	Total	4 958 238	221 156	4 976 915	177 970
8105.90	Cobalt and articles thereof, n.e.s.				
	United States	12 220	3 238	17 617	4 437
	Germany	12 950	2 290	11 184	3 092
	United Kingdom	385	68	1 116	227
	Austria	56	7	856	223
	Sweden	142	40	396	87
	Mexico	232	42	188	56
	Brazil	401	78	106	21
	China	–	–	73	19
	Dominican Republic	–	–	8	2
	Korea, South	–	–	1	. . .
	Netherlands	64	14	–	–
	Argentina	2 221	19	–	–
	France	61	9	–	–
	Japan	39	6	–	–
	Australia	27	8	–	–
	Total	28 798	5 819	31 545	8 164
	Total exports		237 630		196 439

TABLE 2a (cont'd)

Item No.		2000		2001 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (2)					
2805.00	Cobalt ores and concentrates (cobalt content)				
	Finland	32 275	1 471	39 453	1 316
	United States	3 063	134	16 661	626
	Germany	40 697	576	60 541	589
	Belgium	36 001	878	1 744	115
	Poland	17 385	799	–	–
	Switzerland	376 950	3 494	–	–
	Total	506 371	7 352	118 399	2 646
2822.00.00.10	Cobalt hydroxides (weight of material, not cobalt content)				
	United States	25 133	1 323	31 367	1 270
	Finland	3 717	212	2 553	168
	Belgium	–	–	32	2
	United Kingdom	9	. . .	20	1
	Russia	–	–	–	–
	Netherlands	1 000	61	–	–
	Total	29 859	1 596	33 972	1 441
2822.00.00.20	Cobalt oxides (weight of material, not cobalt content)				
	Belgium	35 750	1 401	55 804	1 968
	Japan	2	. . .	10 005	661
	United States	3 319	143	2 774	140
	Australia	–	–	324	27
	Finland	14 790	486	75	5
	South Korea	5 111	225	–	–
	Total	58 972	2 255	68 982	2 801
2822.00.00.30	Commercial cobalt oxides (weight of material, not cobalt content)				
	South Korea	–	–	22 002	704
	United Kingdom	2 811	57	492	9
	United States	335	6	364	8
	Belgium	10 650	437	–	–
	Total	13 796	500	22 858	721
2827.34	Cobalt chlorides (weight of material, not cobalt content)				
	United States	45 287	668	45 409	703
	Germany	–	–	50	1
	United Kingdom	89	2	23	. . .
	Total	45 376	670	45 482	704
2833.29.00.40	Cobalt sulphate (weight of material, not cobalt content)				
	United States	21 670	396	24 367	399
	Finland	14 557	141	5 946	67
	Brazil	–	–	1 816	25
	Philippines	–	–	1 814	25
	France	500	2	1 000	5
	Russia	–	–	100	1
	United Kingdom	26	. . .	–	–
	Total	36 753	539	35 043	522
2836.99.10.30	Cobalt carbonates (weight of material, not cobalt content)				
	United States	. .	23	. .	89
	Belgium	. .	49	. .	37
	Brazil	–	–	. .	33
	Philippines	–	–	. .	28
	Finland	. .	60	. .	9
	Total	. .	132	. .	196
2836.99.90.20	Other cobalt carbonates (weight of material, not cobalt content)				
	Finland	7 878	188	16 783	367
	United States	19 397	504	12 472	324
	Japan	–	–	–	–
	Total	27 275	692	29 255	691

TABLE 2a (cont'd)

Item No.		2000		2001 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
2915.23	Cobalt acetates (weight of material, not cobalt content)				
	United States	37 120	405	26 645	301
	Japan	. . .	–	13	. . .
	United Kingdom	8	. . .	–	–
	Canada	2	. . .	–	–
	Total	37 130	405	26 658	301
8105.10.10.10	Cobalt waste and scrap fit only for remelting and recovery of the metal content (weight of material, not cobalt content)				
	Congo	–	–	199 616	1 109
	United States	32 517	645	24 553	568
	Germany	4 869	78	481 787	471
	Netherlands	–	–	37 106	151
	Japan	–	–	30 329	71
	United Kingdom	–	–	105	5
	Trinidad and Tobago	443	16	87	5
	Canada	54	1	–	–
	Total	37 883	740	773 583	2 380
8105.10.10.20	Cobalt powders (cobalt content)				
	Australia	250 072	8 393	367 580	9 224
	United States	58 598	3 072	77 744	3 355
	Belgium	119 154	4 838	90 202	2 935
	Finland	–	–	59 403	2 144
	South Africa	84 098	3 770	55 502	1 963
	Switzerland	–	–	13 008	383
	United Kingdom	1 255	82	5 709	324
	Ireland	–	–	6 000	205
	France	297	22	1 469	151
	Japan	95 764	4 580	5 010	57
	Germany	142	10	422	32
	Sweden	14 140	465	136	7
	Russia	–	–	82	6
	Netherlands	44 048	647	–	–
	Hong Kong	121	3	–	–
	Total	667 689	25 882	682 267	20 786
8105.10.10.30	Unwrought cobalt, not alloyed (cobalt content)				
	Congo	25 614	902	26 907	921
	Zambia	–	–	4 000	152
	United States	9 604	431	1 502	81
	Ireland	–	–	83	3
	Belgium	–	–	15	1
	Switzerland	540	14	–	–
	Russia	3 026	132	–	–
	Japan	7 140	292	–	–
	Bahamas	6 536	293	–	–
	Total	52 460	2 064	32 507	1 158
8105.10.90	Unwrought cobalt, alloyed, mattes and other intermediate products of cobalt metallurgy (cobalt content of unwrought and mattes; weight of material for intermediates and alloys)				
	United States	7 296	355	14 706	473
	Japan	–	–	284	4
	Switzerland	3	. . .	–	–
	Total	7 299	355	14 990	477
8105.90.00.10	Cobalt bars and rods, not alloyed (cobalt content)				
	United States	2 180	169	4 550	422
	Canada	2	. . .	97	6
	Japan	18	2	55	3
	Switzerland	–	–	26	2
	United Kingdom	130	8	–	–
	Total	2 330	179	4 728	433

TABLE 2a (cont'd)

Item No.		2000		2001 (p)	
		(kilograms)	($000)	(kilograms)	($000)
IMPORTS (cont'd)					
8105.90.00.90	Cobalt and articles thereof, n.e.s. (cobalt content)				
	United States	53 388	6 391	51 051	6 558
	Canada	785	60	999	75
	Belgium	611	48	997	69
	United Kingdom	947	52	459	25
	China	50	2	8	1
	Japan	36	3	10	1
	Germany	798	74	1	. . .
	Switzerland	69	6	–	–
	Mexico	20	2	–	–
	Total	56 704	6 638	53 525	6 729
	Total imports		49 999		41 986
	Total exports		237 630		196 439
	Net exports		187 631		154 453

USE (3)	1999	2000	2001
		(kilograms)	
Cobalt contained in:			
Cobalt metal and metallic compounds	49 340	46 698	. .
Cobalt pigments, feed and ground coat frit	8 378	8 487	. .
Cobalt salts and driers and other uses (4)	72 270	71 530	. .
Total	129 988	126 715	. .

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available or not applicable; . . . Amount too small to be expresssed; (p) Preliminary.

(1) This total includes cobalt refined production sourced from both domestic and imported feed materials, including mixed Ni-Co sulphides from Cuba. (2) Nickel-cobalt sulphides as reported by the International Nickel Study Group (imported into Canada under classification HS 2620.90 Ash and Residue). This material shown in Table 1a includes both the weight and value of imported nickel and cobalt from Cuba and is not included in this table. (3) Available data as reported by users. (4) Other uses include glass and chemicals.

Notes: Numbers may not add to totals due to rounding. The absence of a tonnage and value for the cobalt being imported from Cuba (total value shown in nickel Table 1a, entry 2620.90) in the mixed nickel-cobalt sulphides from Cuba means that the total imports shown are less than the actual imports.

TABLE 2b. CANADA, COBALT PRODUCTION, TRADE AND USE, 1975 AND 1980-2001

	Concentrate Shipments (1)	Processed Cobalt Exports (2)	Cobalt Oxide and Hydroxide Exports	Cobalt Ore and Concentrate Exports (3)	Cobalt Oxide and Hydroxide Imports (4)	Use (5)
			(tonnes)			
1975	1 354	431	561	. .	. .	123
1980	2 118	325	1 091	2	26	105
1981	2 080	677	601	24	20	101
1982	1 274	585	212	2	30	81
1983	1 410	885	192	45	30	101
1984	2 123	1 487	373	14	27	113
1985	2 067	1 551	268	36	192	101
1986	2 297	1 805	374	20	31	96
1987	2 490	1 875	440	45	38	120
1988	2 398	3 062	953	98	37	159
1989	2 344	3 262	371	22	33	147
1990	2 184	3 039	391	–	73	194
1991	2 171	3 456	459	–	42	166
1992	2 223	2 963	489	–	64	205
1993	2 150	3 581	394	–	52	187
1994	1 846	3 922	204	–	81	193
1995	2 016	4 227	–	–	41	148
1996	2 150	(r) 4 488	632	–	33	147
1997	2 168	5 829	526	–	39	136
1998	2 262	6 592	457	–	45	146
1999	2 014	6 307	224	10	114	130
2000	2 022	4 987	335	–	103	127
2001 (p)	2 048	5 008	355	–	126	. .

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available; (p) Preliminary; (r) Revised.

(1) Production includes recoverable cobalt in concentrates shipped. Beginning in 1988, exports and imports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. (2) Processed cobalt includes all forms classified in HS code 8105.10 (intermediate forms such as cobalt in matte, unwrought cobalt, alloyed cobalt, waste or scrap of cobalt, cobalt powders) plus all forms classified in HS code 8105.90 (cobalt and articles thereof, not elsewhere specified). (3) Cobalt content. From 1975 to 1988, cobalt recovered in Canada from domestic concentrate plus exports of payable cobalt in concentrate. Starting in 1989 to date, recoverable cobalt in concentrates shipped. (4) Gross weight. Producers' domestic shipments of refined cobalt plus imports of refined shapes. (5) Use of cobalt in metal, oxides and salts; available data as reported by user.

TABLE 3. CANADIAN NICKEL PRODUCERS - SOURCES FOR ADDITIONAL CORPORATE INFORMATION ON THE INTERNET

Full Corporate Name	Web Site	SEDAR Site (English)
Canmine Resources Corporation	www.canmine.com	<www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00012293&lang=EN>
Falconbridge Limited	www.falconbridge.com	<www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00000376&lang=EN>
Inco Limited	www.inco.com	<www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00001084&lang=EN>
North American Palladium Ltd.	www.napalladium.com	<www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00003026&lang=EN>
Sherritt International Corporation	www.sherritt.com	<www.sedar.com/command_servlet?cmd=DisplayCompanyDocuments&issuerNo=00002460&lang=EN>

TABLE 4. CANADIAN NICKEL PRODUCERS

Company	Location	Operation	Production Data Nickel 2000	 Nickel 2001	 Nickel 2002 (pf)	 Cobalt 2001	Type of Ni Output	Remarks
				(t)				
Canmine Resources Corporation	Cobalt, Ont.	Hydrometallurgical refinery	–	–			Ch	Refinery commissioning started in Dec. 2001; scheduled to be completed in late Q1 2002; initial capacity of 300 t/y Co in chemicals plus by-product Ni in chemicals.
Falconbridge Limited	Katinniq, in Nunavik territory, Que.	Raglan mine/mill (a)	23 089	24 570	26 000	318	S	Mill optimization completed, mill operated at capacity in Q4; forecast production for 2002 of 26 000 t Ni in concentrate (Jan. 2002 forecast).
Falconbridge Limited (1)	Sudbury, Ont.	**Sudbury Operations** (a)						
		Craig mine, u/g	15 300	17 300			SO	Ni in ore mined, rounded to nearest 100 t; production in 2000 and 2001 was affected by a labour strike.
		Fraser mine, u/g	6 800	7 300			SO	Ni in ore mined, rounded to nearest 100 t; production in 2000 and 2001 was affected by a labour strike.
		Lindsley mine, u/g	2 800	3 600			SO	Ni in ore mined, rounded to nearest 100 t; production in 2000 and 2001 was affected by a labour strike.
		Lockerby, u/g	3 300	3 100			SO	Ni in ore mined, rounded to nearest 100 t; production in 2000 and 2001 was affected by a labour strike.
		Total	28 100	31 300				
		Strathcona mill	23 234	25 226	27 000	880	S	10 000-t/d capacity; mill produces bulk concentrate for shipment by truck to company smelter at Falconbridge, Ontario; production in 2000 and 2001 was affected by a labour strike.
		Smelter	47 430	54 892		1 788	M	Processes concentrate from Falconbridge's Sudbury and Raglan operations plus recyclable Ni, Co, Cu; SO_2 is captured to make sulphuric acid; matte is exported to Falconbridge's Nikkelverk refinery in Norway; provincial permission to export up to 45 360 t/y of recoverable Ni in matte until end of 2009; new draft SO_2 regulations issued in September cutting emission limit by 33% by 2007 and ground level concentration to 0.34 ppm by April 2002; production in 2000 and 2001 was affected by a labour strike.
Inco Limited	Sudbury, Ont.	**Sudbury Operations** (2) (b,e)						
		Copper Cliff North mine, u/g					SO	Nominal ore production rate = 900 000 t/y; capacity = 2800 t/d.
		Copper Cliff South mine, u/g					SO	Nominal ore production rate = 1 000 000 t/y; capacity = 3000 t/d.
		Crean Hill mine, u/g					SO	Nominal ore production rate = 1 000 000 t/y; capacity = 3000 t/d.
		Creighton mine, u/g					SO	Nominal ore production rate = 1 100 000 t/y; capacity = 4000 t/d.
		Garson mine, u/g					SO	Nominal ore production rate = 700 000 t/y; capacity = 2000 t/d.
		Lower Coleman mine, u/g					SO	Mine closed in 2001 except for lower portion; previous capacity was 1400 t/d of ore.

TABLE 4 (cont'd)

Company	Location	Operation	Production Data Nickel 2000	 Nickel 2001	 Nickel 2002 (pf)	 Cobalt 2001	Type of Ni Output	Remarks
					(t)			
Inco Limited (cont'd)		McCreedy East mine, u/g					SO	Nominal ore production rate = 1 200 000 t/y including Lower Coleman production; capacity of McCreedy East = 2800 t/d of ore.
		Stobie mine, u/g					SO	Includes remaining operations at Frood mine; nominal ore production rate = 3 500 000 t/y; capacity = 8300 t/d of ore.
		Clarabelle mill					S	36 000-t/d mill takes output of all Inco's Sudbury area mines; improved recovery of Ni by 3.4% since 1999; head grade of 1.57% Ni, 1.68% Cu in 2001.
		Nickel smelter					M	Twin flash smelters; slow cooling of matte, then milling to separate to Ni and Cu streams; matte is sent to matte plant, refinery in Sudbury basin, or refinery in United Kingdom; capacity 100 000 t/y Ni in matte.
		Matte processing plant					II	Produces Ni oxide sinter for export to refineries in Korea and Taiwan or for use in stainless steel industry.
		Nickel refinery					I	59 000-t/y carbonyl refinery producing high-purity Ni pellets, powders and foams.
	Clydach, United Kingdom	Nickel refinery (c)	38 000	33 800			I	Carbonyl refinery producing high-purity Ni pellets, powders and foams from Sudbury feed; returns residue to Canada for reprocessing; Co oxide produced from feed exported from Thompson, about 20% of Inco's Co production in 2001 was in the form of Co oxide; Ontario government permission to export Ni sulphide matte, Ni sulphate residues, Ni oxide sinter, and PGMs concentrates until year-end
		Total of Sudbury plus U.K. finished Ni production (d)	98 000	95 000	104 300			Clydach is part of the Ontario and U.K. division of Inco.
		Cobalt originating from Sudbury ores						61% of Inco's Co production is sourced from Inco's Ontario ores; Inco produced 1450 t of Co in 2001 according to The Cobalt Development Institute.
	Port Colborne, Ont.	Co refinery (b)						Produces refined Co from Ni-Co carbonate feed from Sudbury; Au, Ag, PGMs separated for further treatment at other sites; PGMs are sent to Inco's Acton, U.K. plant for final recovery; capacity 1360 t/y refined Co; about 80% of Inco's Co production is metal; Inco produced 1450 t Co in 2001 according to The Cobalt Development Institute.
	Thompson, Man.	**Manitoba Operations** (b) Thompson mine, u/g					SO	1-D orebody production increased 20% in 2001; ongoing and future exploration for additional ore reserves underground and in area; investigation of bio-assisted heap leaching.
		Birchtree mine,u/g					SO	Upper part of mine producing at 1635 t/d of ore; US$48 million shaft deepened and mine extension approved in 2000 to access 13.6 Mt grading 1.79% Ni to extend mine life by 15 years and increase production by 90%; shaft deepened in 2001, new skips installed in Q1 of 2002, ore hoisting from new ore zones commenced; ramp up to full production targeted at late 2003.
		Manitoba finished Ni production (d)	45 800	49 000	49 900			

		Cobalt originating from Thompson ores (d)						25% of Inco's Co production is sourced from Manitoba production; some is sent to Clydach and some is sent to Port Colborne; about 20% of Inco's production is in form of Co oxide; Inco produced 1450 t of Co in 2001 according to The Cobalt Development Institute.
		Thompson mill (b,d)					S	13 000-t/d mill; head grade in 2001 was 2.46% Ni.
		Thompson smelter					M	Electric furnace smelts partially roasted Ni concentrates from Thompson; Cu concentrate is sent to Sudbury for smelting; smelts Ni concentrates from Cosmos mine in Australia.
		Thompson refinery					I	55 000-t/y electrolytic Ni refinery produces rondelles and cathodes, majority of which is used for electroplating applications, Co hydrate is sent to Port Colborne for recovery; Co oxide is sent to the U.K. for processing.
The Cobalt Refinery Company Inc.	Fort Saskatchewan, Alta.	Hydrometallurgical nickel and cobalt refinery (f)	28 070	29 225		2 943	I	Sherritt International Corporation and General Nickel Company S.A. (owned by the Cuban Ministry of Basic Industries) together own a 50:50 joint venture called Metals Enterprise, which owns The Cobalt Refinery Company Inc.; refinery output progressively increased over past years by de-bottlenecking; produces by-product fertilizer.
North American Palladium Ltd.	85 km from Thunder Bay, Ont.	Open-pit mine and mill (g)	470	728			S	Open-pit palladium mine with by-product nickel production; expansion to 15 000 t/d from 2400 t/d, new mill commissioned in June; throughput lower than expected; additional modifications expected in 2002 to bring operation to capacity; concentrates sent to Inco and Falconbridge Sudbury smelters.

Sources: Various annual reports, web sites, industry publications and press releases. Some specific sources are noted below:

(a) Falconbridge Annual Report and Annual Information Form.
(b) *Canadian Mining Journal*, April-May 2002.
(c) Refined Ni production of U.K. according to INSG; Clydach is the sole primary Ni refinery in the U.K.
(d) Inco Annual Report and 10K report.
(e) *Mining and Mineral Processing Operations in Canada*, 2000-2001, Natural Resources Canada.
(f) Sherritt International Corporation Annual Report 2001.
(g) North American Palladium Annual Report 2001.

(pf) Preliminary forecast; ppm Parts per million.
Ch = Ni in chemicals.
I = Class I Ni (e.g., cathodes, briquettes, pellets, powders, etc., which have a Ni content of 99% ore more).
II = Class II Ni (e.g., products with a Ni content of less than 99% such as FeNi, NiO, UTILITY™ Ni).
M = matte.
S = sulphide concentrates.
SO = sulphide ore mined.
(1) Falconbridge Limited's production in 2000 and 2001 was affected by a labour strike.
(2) Nominal production as reported in the *Canadian Mining Journal*, April/May 2002; capacity as reported in 2000-01 *Mining and Mineral Processing Operations in Canada*, MR 251, Natural Resources Canada; data are for different periods and may not agree.

TABLE 5. LIST OF WORLD NICKEL PRODUCERS

Country	Full Corporate Name or Identifier	Web Site
Albania	Bitincka mine	www.larco.gr
Australia	Anaconda Nickel Limited	www.anaconda.com.au
	Goldfields Mine Management Pty Ltd.	(unknown)
	Jubilee Gold Mines NL	www.jubileemines.com
	LionOre Australia (Nickel) Ltd.	www.lionore.com
	Miitel JV	www.mincor.com.au
	OM Group, Inc. (OMG)	www.omgi.com
	Outokumpu Mining Australia Pty. Ltd.	www.outokumpu.com
	Preston Resources Limited	www.prestonres.com.au
	QNI Ltd.	www.qni.com.au; www.bhpbilliton.com
	Tectonic Resources NL	www.tectonicres.com.au
	Titan Resources NL	www.titanresources.com.au
	WMC Limited	www.wmc.com
Austria	Treibacher Industrie AG	www.treibacher.at/en/index.html
Botswana	BCL Limited	(unknown)
	Tati Nickel Mining Company (Proprietary) Limited	www.lionore.com; www.angloamerican.co.uk
Brazil	Barro Alto Mineração Limitada project	www.angloamerican.co.uk
	Codemin SA	www.angloamerican.co.uk
	Companhia Niquel Tocantins	www.vmetais.com.br/homecnt.htm
	Mineração Serra da Fortaleza Limitada	www.riotinto.com
Canada	Canmine Resources Corporation	www.canmine.com
	Falconbridge Limited	www.falconbridge.com
	Inco Limited	www.inco.com
	North American Palladium Ltd.	www.napalladium.com
	Sherritt International Corporation; The Cobalt Refinery Company Inc.; Metals Enterprise	www.sherritt.com
China	Jilin Nickel Co.	www.jlnickel.com.cn/edefault.htm
	Jinchuan Nonferrous Metals Corporation	www.jnmc.com
	Jinco Nonferrous Metals Co., Ltd.	www.inco.com; www.jnmc.com
	Sichuan Copper-Nickel Co.	(unknown)
	Simsen Metals (Holdings) Ltd.	(unknown)
	Tonghua Ni Cu mine (corporate name unknown)	(unknown)
	Huili Ni mine (corporate name unknown)	(unknown)
	Xinjiang Nonferrous Metals Industry Corporation	(unknown)
Colombia	Cerro Matoso S.A.	www.bhpbilliton.com
Cuba	Moa Nickel S.A.	www.sherritt.com
	Union del Niquel	(unknown)
Dominican Rep.	Falconbridge Dominicana, C. por A.	www.falconbridge.com
Finland	Kokkola Chemicals Oy	www.omgi.com
	OM Group, Inc.	www.omgi.com
	OMG Harjavalta Nickel Oy	www.omgi.com
	Outokumpu Oyj	www.outokumpu.com
France	Eramet Group, The	www.eramet.fr
Former Yugoslav Republic of Macedonia	Feni-Rudnici i Industrija za Nikel, Celik i Antimon (FENI)	www.baryte.com
Greece	General Mining and Metallurgical Co. S.A.	www.larco.gr
Indonesia	PT Antam Tbk	www.antam.com
	PT International Nickel Indonesia Tbk	www.inco.com
Japan	Hyuga Smelting Co., Ltd.	www.smm.co.jp
	Inco TNC Limited	www.inco.com
	Nippon Yakin Kogyo Co., Ltd.	www.nyk.co.jp
	Pacific Metals Co., Ltd.	(unknown)
	Sumitomo Metal Mining Co., Ltd.	www.smm.co.jp
Kazakhstan	Kempirsai Mining Directorate	(unknown)

TABLE 5 (cont'd)

Country	Full Corporate Name or Identifier	Web Site
Korea, Rep. of	Korea Nickel Corporation	www.inco.com
New Caledonia	Goro Nickel S.A.	www.inco.com
	Le Nickel-SLN	www.eramet.fr
	Société Minière du Sud Pacifique S.A., La	(unknown)
	Société Minière Georges Montagnat S.A.	(unknown)
	Société des Mines de la Tontouta	(unknown)
Norway	Falconbridge Nikkelverk Aktieselskap	www.falconbridge.com
	Nikkel og Olivin A/S	www.outokumpu.com
	Titania A/S	(unknown)
Philippines	Cagdianao Mining Corporation	(unknown)
	Hinatuan Mining Corporation	(unknown)
	Rio Tuba Mining Corporation	(unknown)
	Taganito Mining Corporation	(unknown)
Russia	MMC Norilsk Nickel	www.nornik.ru/index.jsp?lang=E
	Rezh Nickel Plant Joint Stock Company	(unknown)
	Ufaleynikel Joint Stock Co.	(unknown)
	Yuzhuralnikel Kombinat Joint Stock Co.	(unknown)
Serbia	Ferro-Nickel D.D. Glogovac	(unknown)
South Africa	Anglo American Platinum Corporation Limited	www.angloplatinum.com
	Impala Platinum Holdings Limited	www.implats.co.za
	Lonmin plc	www.lonmin.com
	Nkomati JV	www.avmin.co.za
Taiwan, China	Taiwan Nickel Refining Corporation	(unknown)
Ukraine	Nikomed Limited	(unknown)
United Kingdom	Inco Limited	www.inco.com
Venezuela	Minera Loma de Niquel C.A.	www.angloamerican.co.uk
Zimbabwe	Bindura Nickel Corporation Limited	www.angloamerican.co.uk
	Rio Tinto Zimbabwe Limited	www.riotinto.com
	Makwiro Platinum Mines (Private) Limited	www.zimplats.com

Source: Natural Resources Canada.

TABLE 6. WORLD NICKEL PRODUCERS, 2001

Country	Company	Operation	Nickel Output 2000	Nickel Output 2001	Cobalt in 2001	Type of Ni output	Remarks
				(t)			
Australia	Anaconda Nickel Limited	Murrin Murrin mine, PAL, refinery	12 988	24 991	1 452	I	Ni briquettes produced, listed on LME in Sept.; continued problems in attaining rated capacity; major write-offs in Dec.; arbitration hearing against contractor expected to be heard in early 2002.
	Goldfields Mine Management Pty Ltd	Otter Juan and Cornet mines	–	(e) 2 300		SO	Purchased in May from WMC, ore delivered to WMC for toll milling, concentrate purchased by WMC under long-term contract; ore deliveries in 2001 started in May, production estimated for 2001.
	Jubilee Gold Mines NL	Cosmos mine, mill	5 600	11 000		S	Ni in concentrate sent to Inco smelters in Canada (2001 production rounded to nearest 1000 t); underground extension; Jubilee announced in Nov. it will proceed with underground development after securing A$40 million debt facility from bank.
	LionOre Australia (Nickel) Ltd.	Emily Ann mine, mill	–	110		S	Ni in conc.; contracted to Inco (to be smelted by WMC in Australia); mill construction finished in Oct., reached planned throughput in Q4; resource of 2.1 Mt @ 3.98% Ni.
	Miitel JV	Miitel and Wannaway mines	–	7 227	132	SO	JV of Mincor, Clough, and Donegal mining former WMC mines; WMC mills ore and buys conc., Wannaway mine purchased in Sept.; reserves at Miitel, Wannaway and Redross mines expected to last at least five years.
	OM Group, Inc. (OMG)	Cawse mine, PAL, refinery	6 639	?	?	I	Refinery closed in early 2002 after OMG purchase; Ni-Co intermediate to be shipped to OMG refinery in Finland; no production data released.
	Outokumpu Mining Australia Pty. Ltd.	Black Swan mine, mill	16 600	21 800		S	Ni in concentrate sent to Outokumpu refinery in Finland; Outokumpu considering selling property; ore production about 0.5 Mt/y.
	Preston Resources Limited	Bulong mine, PAL, SXEW	5 216	6 977	379	I	Produces Ni cathode, Cu metal, Co in sulphide; lower throughput and operating problems during year; tentative agreement with major creditors to surrender 95% of equity for release from debt agreements; R&D testing program started for atmospheric laterite leaching; tested Ni-Co residues from WMC's refinery.
	QNI Ltd.	Yabulu refinery; ammonia leach	26 713	28 500	1 800	I	Imports limonitic laterite ore from New Caledonia (70% feed), Philippines (7%), Indonesia (23%); expansion to 65 000 t/y being studied to handle expected output of Ravensthorpe project, Western Australia, under consideration.
	Tectonic Resources NL	RAV 8 mine, mill	2 730	4 008		S	Shipped Ni in concentrate to WMC's Kalgoorlie smelter; milling closed end of 2001 and mill will ship to WMC mill; underground exploration of two orebodies at site ongoing at year-end.
	Titan Resources NL	Radio Hill mine, mill		4 755	264	S	Ni in concentrate shipped to WMC smelter at Kalgoorlie; conc. contains Cu, Co and Pd as well.
	WMC Limited	Kambalda mines, mill	19 202	18 653		S	Ni in concentrate is sent to WMC smelter at Kalgoorlie; mill takes ore from various WMC properties sold in 2000 and 2001; in 2002, Tectonic mine ore will be shipped to WMC's Kambalda mill.
	WMC Limited	Leinster mines, mill	40 724	38 008		S	Ni in concentrate is sent to WMC smelter at Kalgoorlie.
	WMC Limited	Mt. Keith pit, mill	47 532	47 930		S	Record output in 2001. Yakabindie orebody purchased from Rio Tinto; prefeasibility study under way to expand Mt Keith using Yakabindie and North Six Mile deposits.
	WMC Limited	Kalgoorlie smelter	103 019	96 650	1 000	M	700 000 t of concentrate smelted, including 19 717 t from third parties such as Miitel JV; matte surplus to needs of Kwinana exported to Japan (Sumitomo) and Finland, totaling 35 000 t; production forecast for 2002 is 92 000 t; Co in mixed sulphide residue is sent to Europe for recovery.
	WMC Limited	Kwinana refinery	60 532	61 324		I	Refinery upgraded to 67 000-t/y capacity; record output in 2001; debottlenecking could take capacity to 70 000 t/y; conceptual plans to increase capacity to 80 000 t/y and beyond.
	Treibacher Industrie AG	FeNi smelter	1 300	1 300	–	II	Takes scrap to produce FeNi.

Botswana	BCL Limited	Mines, mill and smelter at Selebi Phikwe	21 446	22 454	325	M	Own mines supply concentrate to smelter, supplemented by Tati feed; matte is sent to Nikkelverk in Finland and to Bindura in Zimbabwe.
	Tati Nickel Mining Company (Proprietary) Limited	Selkirk u/g and Phoenix pit, dry magnetic mill	8 547	8 177	26	S	Selkirk u/g mine direct ships ore, to close in first half of 2002; Phoenix open-pit expansion and wet mill expansion to be completed in 2002 and production to nearly double; mine paid for about 77% of Ni shipped to BCL; Centametall buys mine output; BCL management of mine to end in 2002; payable production in 2001 was 6305 t Ni.
Brazil	Codemin SA	Niquelandia mine, smelter	6 300	5 800	–	II	Mandatory power rationing in second half of 2001 caused 25% reduction in throughput, partially offset by higher-grade feed; reserves only until about 2007; produces FeNi.
	Mineração Serra da Fortaleza Limitada	Fortaleza mine, mill, smelter	8 738	10 170		M	Ni matte is sent to OMG refinery in Finland.
	Companhia Niquel Tocantins	Tocantins mine, ammonia leach plant at Niquelandia; refinery at Sao Paulo	16 906	16 700	890	I	Announced plan to increase capacity from 17 000 t/y Ni to 21 000 t/y in 2002 and Co capacity from 780 t/y to 1100 t/y, thereafter to increase to 21 000 t/y Ni in 2004, built power generation facilities due to power rationing instituted in mid-year.
Canada	Canmine Resources Corporation	Cobalt hydrometallurgical refinery	–	–	–	Ch	Refinery plans to produce Ni by-product in 2002 in order of 100 t.
	Falconbridge Limited	Raglan mine, mill	23 089	24 570	318	S	Record production in 2001; output forecast at 26 000 t of Ni in concentrate in 2002.
	Falconbridge Limited	Sudbury - 4 u/g mines, mill, smelter	54 900	47 400	630	M	Ni-Cu-Co matte exported to Nikkelverk refinery in Norway; operation returned to normal output in June after 6½-month strike that ended in late Feb.; mining of Onaping Deep orebody being studied; produced about 3000 t of Ni in matte from recyclables in 2001; encouraging drill results near Nickel Rim deposit to be further explored in 2002; production forecast for 2000 = 27 000 t Ni in concentrate.
	Falconbridge Limited	Montcalm deposit	–	–	–	SO	Purchased in Q2; potential to produce 8000 t/y Ni in concentrates; ore to be milled at Falconbridge's Kidd Creek operation, then concentrate sent to Sudbury for smelting; plans call for initial production in 2004, subject to decision to proceed.
	Inco Limited	Port Colborne refinery and processing facilities	–	–	n/a		Produces electrolytic cobalt metal, about 80% of Inco's Co production is produced as metal; capacity reported as 1360 t/y Co; upgrading of PGMs, Au and Ag; class action suit filed for C$750 million for past emissions being opposed by Inco.
	Inco Limited	Sudbury - 8 u/g mines, mill, smelter, matte processing, carbonyl refinery	98 000	95 000	n/a	I,II	Pellets, powder, NiO sinter; Crean Hill mine to close in 2002, cobalt recovered at Port Colborne; PGMs are sent to Inco facility at Acton in U.K. Production data include 38 000 t Ni in 2000 and 33 800 t in 2001 produced at Clydach.
	Inco Limited	Thompson - 2 u/g mines, mill, smelter, electro-refinery	45 800	49 000	n/a	I	Cathode, rondelles; 470-t/y capacity to produce Co oxide.
	The Cobalt Refinery Company Inc.	Fort Saskatchewan - hydromet refinery using ammonia	28 070	29 225	2 943	I	(Sherritt/Cubaniquel JV) record output at 32 000 t/y Ni and 3200 t/y Co plant; takes 93% of Ni feed from Moa Nickel S.A.
	North American Palladium Ltd.	Lac des Iles - open-pit mine, mill	470	728		S	Ni contained in PGM concentrate sent to Inco and Falcobridge in Sudbury; mine/mill expansion from 2700 t/d to 15 000 t/d with mill commissioned in June; mill throughput problems being addressed.
China	Cu-Ni mine (company name unknown)	Tonghua Cu-Ni mine	?	?		S	Cu-Ni mine; capacity and output unknown.
	Ni mine (company name unknown)	Huili Nickel mine and smelter	?	?		M	Reportedly a mine and smelter with capacity of about 1400 t/y Ni.
	Jilin Nickel Co.	3 mines, smelter, refineries	?	?		M,I	Capacity 9500 t/y Ni in matte and 1000 t/y Ni cathodes plus 3500 t/y Ni hydroxide; recent production data not available; production in 1998 said to be about 5000 t Ni; smelts Ni concentrate from other producers.
	Jinchuan Nonferrous Metals Corporation	Mines, mill, smelter, refinery	40 000	(e) 50 000	(e) 750	I, Ch	Various estimates for production in 2001 estimated Co production in 2001 between 750 and 1000 t.
	Sichuan Copper-Nickel Co.	Chengdu refinery	?	?		I	Refinery; capacity and output unknown.
	Simsen Metals (Holdings) Ltd.	Mine	?	?		S	Started up in 1999; ships concentrate to Jinchuan; forecast from 1999 that production would be 1500 t contained Ni in 2000.
	Xinjiang Nonferrous Metals Industry Corporation	Kalatongke	?	?		M,I	Ni-Cu mine, smelter, refinery; capacity and output unknown.

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output		Cobalt in 2001	Type of Ni output	Remarks
			2000	2001			
				(t)			
Colombia	Cerro Matoso S.A.	Cerro Matoso mine, FeNi smelter	27 800	38 500	–	II	FeNi produced; US$500 million expansion started up Jan. 2001, capacity will reach 55 000 t/y after ramp-up, mining rate increased to 2.5 Mt of ore in 2001 compared to 1.2 Mt in 1999.
Cuba	Union del Niquel	Commandante Ernesto Che Guevara Mining and Metallurgical Combine (Punta Gorda) mine and refinery	(e) 30 500	(e) 32 200	(e) 975	II,S	NiO sinter produced for export plus Ni-Co in mixed sulphide produced and exported to Canada and China, production said to be "over 31 000 t" in 2001; *production in 2001 estimated by author after site visit (production in 2000 estimated by taking INSG Cuban production of 39 994 t of Ni in NiO less reported Nicaro production plus an estimated 1950 t of Ni in sulphides)*
	Union del Niquel	Commandante Rene Ramos Latour Mining and Metallurgical Combine (Nicaro) mine and refinery	10 780	(e) 11 000		II	NiO sinter produced for export; *2001 production estimated by author*
	Moa Nickel S.A.	Pedro Sotto Alba mine, PAL (e)	26 800	(e) 29 400	(e) 2 950	T	New mining area commenced in 2001, produces mixed Ni-Co sulphide for export to Fort Saskatchewan, Canada, production data released as Ni+Co contained *(ratio of Ni:Co output for Fort Saskatchewan refinery used to estimate Ni and Co tonnage, data rounded and approximate)*
Dominican Republic	Falconbridge Dominicana, C. por A.	Falcondo mine, FeNi smelter	21 662	27 800	–	II	FeNi produced; mine was shut from October to year-end due to low Ni prices.
Finland	Outokumpu Oyj	Hitura mine, mill	2 000	2 600	?	S	Conc. is sent to Harjavalta smelter, mine was to have closed in 2001 but averted by agreement with OMG, which needs feed for its refinery at Harjavalta.
	Outokumpu Oyj	Harjavalta smelter (e)	(e) 35 600	(e) 36 500		M	Matte is sent to OMG refinery on site; *(production in 2001 and 2000 estimated by author using reported refined Ni production in Finland less imported matte reported for each year; estimate rounded)*.
	OMG Harjavalta Nickel Oy	Harjavalta refinery	50 600	54 600	?	I	Data are INSG production of refined nickel for Finland.
France	The Eramet Group	Sandouville refinery	12 276	13 033	199	I,Ch	Takes matte from Doniambo as feed for Ni cathodes and Ni chloride; cobalt chloride is also produced; 10% cost reductions achieved through debottlenecking under "Sandouville Demain" program initiated in 1998.
Former Yugoslav Republic of Macedonia	Feni-Mak	Feni-Mak mines, FeNi smelter	–	3 000		II	June start-up reported, ramp-up to 500 t per month Ni in FeNi by Sept., 2001 production per INSG stats; plant purchased in 2000 by Feni-Rudnici i Industrija za Nikel, Celik i Antimon (FENI) of France.
Greece	General Mining and Metallurgical Co. S.A.	Larco mines, FeNi smelter	18 000	19 600	–	II	US$30 million investment announced in 2001; imports some ore from Albanian mine; production data per INSG; government to privatize operation; produces FeNi.
Indonesia	PT Antam Tbk	Gebe, Pomalla, Gee, Buli mines	(e) 41 000	(e) 49 000	–	L	Gebe, Pomalaa, Gee and Buili mines, produced 2.5 Mt (wet) high-grade saprolite ore + 1.1 Mt wet limonitic ore in 2001 (2.1 Mt and 0.93 Mt in 2000), high-grade ore shipped to Japan and limonitic ore shipped to QNI; mines supply own FeNi plant at Pomalaa, Buili mine started up in Q3; export contracts with Japanese FeNi smelters increased to 2.1 Mt (wet) for period June 2001 to May 2002 from 1.32 Mt (wet) one year earlier to compensate for Japanese smelters' loss of feed due to SMSP cessation of exports of garnieritic (high-grade) laterite ore to Pamco. *(Production estimated by author using reported shipments and reserve grades, as well as moisture contents for ore reserves.)*
	PT Antam Tbk	Pomalaa FeNi I and FeNi II plants, smelter lines	10 111	10 302	–	II	One furnace shut in July due to water leak, restarted in August causing loss of about 1150 t Ni in FeNi production; PT Antam sent 65 000 wet t ore to Pamco for toll smelting; FeNi III project to increase capacity from 11 000 t/y to 24 000 t/y Ni in FeNi being reviewed by German Credit Agency; estimated cost of expansion is US$228 million.
	PT International Nickel Indonesia Tbk (PT Inco)	Soroako mine, smelter	59 200	62 600	–	M	Smelter expansion to 150 million lb/y (68 000 t/y) completed in 2000; talks with PT Antam about joint development of Inco's orebodies at East Pomalaa, forecast production for 2002 of 60 000 t Ni in Ni matte (production below capacity due to furnace rebuild).

Japan	Hyuga Smelting Co., Ltd.	FeNi smelter at Hyuga, Miyazaki Prefecture	19 618	19 130	–	II	Owned 60% by Sumitomo, intention to expand production to 25 000 t/y Ni in FeNi from current 19 000 t/y announced in 2000, no construction begun in 2001; obtains feed from New Caledonia and Indonesia.
	Inco TNC Limited	Nickel refinery located at Matsauzka, Mie Prefecture	(e) 48 000	(e) 48 000	–	II	Estimated production from Tex Report; imports matte from PT Inco to produce NiO for use in other refineries in which Inco has interests (16 600 t of Ni in NiO to Korea in 2001 and 7400 t to Taiwan) and to produce Class II brands (Tonimet and UTILITY™ Ni).
	Nippon Yakin Kogyo Co., Ltd.	FeNi smelter at Oheyama, Kyoto Prefecture	11 609	12 445	–	II	Announcement in November that contracted imports from PT Antam would be 400 000 t for period June 2001-May 2002, also takes feed from New Caledonia; produces FeNi.
	Pacific Metals Co., Ltd. (Pamco)	FeNi smelter at Hachinohe, Aomori Prefecture	36 538	42 000	–	II	SMSP suspended ore exports to Pamco in Jan.; Pamco toll smelted small amount of ore for PT Antam; will import 900 000 t (wet) of ore from PT Antam in period June 2001 to May 2002 (up from 180 000 t in 2000); imported 1.3 Mt (wet) from Philippine mines, produces FeNi.
	Sumitomo Metal Mining Co., Ltd.	Electroytic refinery at Niihama, Ehime Prefecture	30 500	32 526	350	I	Production using matte imported from Australia and matte from PT Inco in which Sumitomo has a 20% share; mid-2001 announcement that Sumitomo would proceed with PAL plant at Rio Tuba to produce 10 000 t/y Ni and 700 t/y Co in intermediates to be processed at Niihama plant starting in 2004.
Kazhakstan	Kempirsai Mining Directorate	Laterite mines	2 000	?	–	L	Estimated Ni content of ore exported to FeNi plants in Russian Federation in 2000.
Korea	Korea Nickel Corporation	Onsan refinery	26 500	28 000		II	Produces Class II Ni (UTILITY™ grade at 97%); feed includes NiO feed from Inco Sudbury operation and Inco TNC in Korea.
New Caledonia	Société des Mines de la Tontouta (SMT)	Nakety, Moneo and Karenbe mines and Nakety/Bogata project with Argosy/Norilsk			–	L	Exports ore to Japan (saprolite) to Hyuga; 284 000 t (wet) in 2001 and 282 000 t (wet) in 2000; MMC Norilsk Nickel is buying into an Argosy Minerals Inc.-SMT project to develop a 6-Mt/y mine and plant to produce NiCo sulphide intermediates, Norilsk will fund a bankable feasibility study.
	Le Nickel-SLN	Doniambo FeNi smelter	57 463	58 973	–	II, M	Produces FeNi and Ni in matte in ratio of about 4:1; matte is sent to Eramet refinery in France at Sandouville and FeNi sold to end users.
	Le Nickel-SLN	Kouaoua, Nepoui Kopeto, Tiebaghi, Thio, and Poro mines	?	?		L	Mined 3.6 Mt (wet) compared to 3.7 Mt (wet) in 2000, of which 92% was garnieritic, almost all shipped to the company's FeNi smelter in New Caledonia; SLN exported garnieritic ore to Japan in 2001: 167 000 t (wet) exported to Nippon Yakin and 18 000 t (wet) to Hyuga; limonitic production was exported in 2001 to QNI in Australia.
	La Société Minière du Sud Pacifique S.A.	Various mines on both coasts and Koniambo project with Falconbridge	?	?	?	L	Owned by investment agency of the Northern Province; ceased shipments of 1 Mt/y (wet) garnieritic ore to Pamco in Jan., reducing total exports to Japan from 1.2 Mt in 2000 to 439 000 t in 2001; also shipped 2 Mt (wet) of limonitic ore to QNI in Australia; to hold 51% of Koniambo project being studied by Falconbridge (60 000 t/y of Ni in FeNi planned).
	Société Minière Georges Montagnat S.A.	Tontouta open pit	?	?	–	L	Leases Tontouta pit from SLN; exported 224 000 t (wet) garnieritic ore to Pamco in 2001, up from 74 000 t in 2000; also ships limonitic ore to QNI in Australia.
Norway	Nikkel og Olivin A/S	Mine, mill	2 300	2 500	(e) 90	S	Mine to close in July 2002 when ore reserves exhausted; owned by Outukumpu; contained estimated 90 t Co in concentrate in 2001.
	Falconbridge Nikkelverk Aktieselskap	Nikkelverk refinery	58 679	68 221	3 314	I	Takes matte from Falconbridge's Sudbury smelter, from BCL and from other sources; production in 2000 and 2001 affected by feed shortages due to strike at Falconbridge Sudbury operations; forecast production 76 000 t Ni in 2002 and 86 000 t in 2003; new feed supply will be matte originating from Tati mine and smelted at BCL.
	Titania A/S	TiO, magnetite mine	400	400	?	S	By-product low-grade Ni concentrate is sent to Outokumpu's smelter at Harjavalta, Finland.
Philippines	Cagdianao Mining Corporation	Mine	5 050	3 000		L	Ships ore to Pamco.
	Hinatuan Mining Corporation	Mine	5 500	-		L	Hinatuan mine reserves exhausted, company refused permission to ship stockpiled ore from former Manikani mine.
	Rio Tuba Mining Corporation	Rio Tuba mine	9 500	4 350	–	L	Ships ore to Pamco.
	Taganito Mining Corporation	Mine located in Suriago del Norte	6 050	13 000		L	Entire output sold to Pamco.

TABLE 6 (cont'd)

Country	Company	Operation	Nickel Output 2000	Nickel Output 2001	Cobalt in 2001	Type of Ni output	Remarks
				(1)			
Russia	MMC Norilsk Nickel	Norilsk - 7 mines, 2 mills, 2 smelter/refineries	?	?	?	I,M	Oktaybrsky mine is source of over 50% of Ni and 55% of PGMs produced in Polar Division (Taimyrsky is 33% and 16% respectively), mine grades are declining
	MMC Norilsk Nickel	Pechanganickel - 3 mines, mill, agglomeration plant, smelter	?	?	?	M	Open-pit mines at Zapolyarny and smelter at Nikel, US$91 million program to reduce SO_2 emissions announced (including US$30 million grant from Norwegian government and US$30 million low-rate loan from Nordic Bank)
	MMC Norilsk Nickel	Severonickel refineries	?	?	?	I	Increasing amount of scrap recycled, also produces small amount of nickel carbonyl
	MMC Norilsk Nickel, all divisions		217 000	223 000	4 600	I	Production data for company released Sept. 24, 2002
	Rezh Nickel Plant Joint Stock Company	Talovsk mine, smelter	?	4 400	?	M	Production reported as 2945 t in first half 2001, then shut on Oct. 1 until year-end due to low Ni prices and high costs, plant produces 13% Ni matte for refining at Ufaleynikel, plant also had some FeNi capacity
	Ufaleynikel Joint Stock Co	Ufaley and Serovskoye mines, refinery	11 000	(e) 9 500	tolls	II, I	Produces FeNi, tolls Ni matte from Rezh plant as well as Co concentrate from MMC Norilsk Nickel, production cut in July and reportedly was shut in October *(author's estimate of production in 2001 based upon 1000 t/month for 9.5 months, Interfax reported 12 000 t of production in 2001), Co tolling rate of 450 t/month reported.*
	Yuzhuralnikel Kombinat Joint Stock Co.	Buruktalskoye mine (Orenburg region) and Sakharinskoye mine (Chelyabinsk region)	7 400	?		L	Yuzhpolymetall, subsidiary of Yuzhuralnikel, leases Ni metal production facilities, *author's estimate for 2000 production based upon 11 months reported data, no information for 2001 production but reportedly in production in early 2002.*
Serbia-Kosovo	Ferro-Nickel D.D. Glogovac	Cikotava and Gllavica laterite mines	–	–	–	II	INSG does not show FeNi production since 1998
South Africa	Anglo American Platinum Corporation Limited	Underground and open-pit mines, smelters, base-metal and precious-metal refineries	19 200	19 500	–	I	Ni is by-product of PGM operations, major expansion of PGM operations likely to result in expanded Ni production capacity by 2006 when Pt production to increase by 70%, smelter convertor program scheduled for completion in Q2 2002 (handles 33 000 t/y Ni in convertor matte); plans to increase platinum production by 70% by 2006 were announced in 2000, implying substantial increase in future by-product nickel production can be expected
	Anglovaal Mining Limited, Anglo American plc	Nkomati JV mine/mill	4 700	4 400	57	S	US$100 million expansion to about 17 500 t/y Ni output being studied, considering Activox™ low pressure process plus SXEW to produce Ni cathodes, Cu cathodes, Co in carbonate; Pd also recovered; mine sends bulk of concentrate to BCL for smelting
	Impala Platinum Holdings Limited	Various mines, smelter and base-metals refinery in Bushveld complex	13 800	14 000		I	Ni is by-product of PGM operations, Impala supplements own feed with tolled and purchased concentrates, plan to study expansion of Ni refinery to handle 40 000 t/y Ni and 4000 t/y Co in intermediate from potential revival of Nonoc operation on hold
	Lonmin plc	Eastern Platinum Limited, Western Platinum Limited mines, smelter and refinery	?	?		Ch	Ongoing US$500 million expansion, Ni is by-product of PGM operation, INSG put capacity at 3000 t/y Ni as Ni sulphate, production data not released, Lonmin plans expansion of platinum production by about 50% from 2001 levels, implying some increase in Ni by-product production can be expected
	Northern Platinum Limited	Mines, mills, smelter, base-metal removal plant	1 500	1 400		Ch	Ni is by-product of PGM operation, produces approximately 1400 t/y Ni in concentrate, which is sold in form of Ni sulphate to Anglo American Platinum Corporation Limited
Taiwan	Taiwan Nickel Refining Corporation	Transforms NiO to make UTILITY™ Ni (97% Ni) at Kaohsiung Hsien	(e) 9 000	(e) 10 000		II	Transforms NiO UTILITY™ Ni, plant output estimated assuming 76% Ni in feed and 99% recovery in process with no changes in inventory; data are not released
Ukraine	Nikomed Limited	Pobuzhsky FeNi smelter	?	1 500		II	Plant purchased by Nikomed Limited, which spent US$10.5 million to refurbish plant and restart it in Q1 2001, SMSP sent two trial shipments of garnierite; one of two furnaces shut in December for repairs to refractory bricks, produces FeNi
United Kingdom	Inco Limited	Clyadach carbonyl refinery	38 000	33 800		I	Takes NiO from Sudbury to produce Ni pellets, foams and powders; residue from refining is returned to Sudbury for reprocessing; data shown is INSG production reported for U.K. These data are counted in Sudbury production totals.

Venezuela	Minera Loma de Niquel, C.A.	Loma de Niquel mine, FeNi smelter	–	9 700		II	US$500 million twin line FeNi plant operation started up in January; first shipment of FeNi in March, ramp up to design capacity of 20 000 t/y forecast for second half of 2002.
Zimbabwe	Bindura Nickel Corporation Limited	Trojan and Shangani mines, smelter, refinery	12 700	12 900		I	Mine reserves at Trojan are 10 years; at Shangani, 5 years; 1.9 Mt mined in 2001; Madziwa mine closed at end of 2000.
	Rio Tinto Zimbabwe Limited	Empress refinery	6 935	6 635	?	I	Toll treats BCL matte plus other material using leach/electrowin process.
	Makwiro Platinum Mines (Private) Limited	Ngezi mine and Selous metallurgical complex mill and smelter	–	–	–	M	Crusher commissioned in Dec.; Ngezi mine to produce at capacity by mid-2002; Phase I production calls for 1300 t/y Ni content in PGM; matte is sent to South Africa for refining.

Sources: Various web sites and press releases as well as commercial publications.

(e) Author estimate.

Ch = Ni content in Ni chemicals; Co = cobalt; FeNi = ferronickel; I = Class I Ni (e.g., cathodes, briquettes, pellets, powders, etc., which have a Ni content of 99% or more); II = Class II Ni (e.g., products with a Ni content of less than 99% such as FeNi, NiO, UTILITY™ Ni); L = laterite ore; M = matte; NiO = nickel oxide; S = sulphide concentrates; SO = sulphide ore mined; T = Ni intermediates such as Ni carbonates, Ni sulphides or Ni hydroxides.

TABLE 7. CANADIAN NICKEL PROCESSING CAPACITY, 2001

	Smelter	Refinery
	(t/y of contained nickel)	
Falconbridge Limited		
Sudbury, Ontario	70 000	n.a.
Inco Limited		
Sudbury, Ontario	100 000	59 000
Sudbury, Ontario (1)	18 000	n.a.
Thompson, Manitoba	63 000	55 000
Sherritt International Corporation		
Fort Saskatchewan, Alberta	n.a.	32 000
Canmine Resources Corporation (2)		
Cobalt, Ontario	n.a.	300

Source: Natural Resources Canada.
n.a. Not applicable.
(1) Produces nickel oxides sinter. (2) Commissioning started in December 2001; production will be cobalt in salts plus by-product nickel in salts.

TABLE 8. WORLD MINE PRODUCTION OF NICKEL,(1) 1997-2001

	1997	1998	1999	2000	2001
			(000 tonnes)		
Russia	235	235	235	235	235
Canada	191	208	186	191	194
Australia	123	144	119	166	198
New Caledonia	137	125	110	128	118
Indonesia	71	74	89	98	102
Cuba	62	68	67	71	76
Colombia	31	29	39	59	53
China	47	48	50	51	52
Brazil	21	33	33	36	36
South Africa	35	36	36	37	36
Other (13 countries)	121	117	94	113	121
Total	1 073	1 117	1 056	1 183	1 221

Source: INSG *World Nickel Statistics* (April 2002).
(1) Ni content of sulphide concentrates or Ni content of lateritic ore mined.

TABLE 9. WORLD PRODUCTION OF PRIMARY NICKEL, 1997-2001

	1997	1998	1999	2000	2001
			(000 tonnes)		
Russia	230	227	228	221	245
Japan	128	127	134	161	154
Canada	132	147	124	134	141
Australia	74	80	79	110	126
Norway	63	70	74	59	68
China	40	40	45	51	50
New Caledonia	44	45	45	44	46
Cuba	34	39	38	40	41
United Kingdom	36	39	38	38	34
South Africa	35	36	36	37	36
Dominican Republic	33	25	24	28	22
Other (13 countries)	164	160	158	161	185
Total	1 012	1 034	1 024	1 083	1 148

Source: INSG *World Nickel Statistics* (April 2002).

TABLE 10. WORLD USE(1) OF PRIMARY NICKEL, 1997-2001

	1997	1998	1999	2000	2001
			(000 tonnes)		
Japan	202	169	182	200	162
United States	156	150	152	150	130
Germany	91	97	101	104	111
Taiwan	68	70	89	90	85
South Korea	66	68	81	78	75
China	43	42	47	62	82
Italy	50	53	55	53	55
France	50	55	52	50	49
Other (more than 27 other countries)	291	305	322	337	349
Total	1 016	1 009	1 081	1 123	1 098

Source: INSG *World Nickel Statistics* (April 2002).

(1) The term "use" replaces "consumption" to reflect the fact that nickel is not being "used up" in its applications; over 500 000 t/y of nickel is recycled yearly, which is not included in the above data.

TABLE 11. AVERAGE ANNUAL NICKEL PRICES, 1981-2001

	Settlement Price	
	(US$/t)	(Converted to US$/lb)
1981	5 985	2.71
1982	4 808	2.18
1983	4 695	2.13
1984	4 783	2.17
1985	4 987	2.26
1986	3 887	1.76
1987	4 849	2.20
1988	14 206	6.44
1989	11 955	5.42
1990	8 880	4.03
1991	8 158	3.70
1992	7 000	3.18
1993	5 283	2.40
1994	6 344	2.88
1995	8 237	3.74
1996	7 500	3.40
1997	6 916	3.14
1998	4 617	2.09
1999	6 015	2.73
2000	8 641	3.92
2001	5 948	2.70

Sources: INSG *World Nickel Statistics* (various issues); London Metal Exchange, *Metal Bulletin* .

TABLE 12. AVERAGE MONTHLY NICKEL PRICES, 1996-2001 (Settlement Price)

	1996	1997	1998	1999	2000	2001
			(US $/t)			
January	7 866	7 047	5 495	4 272	8 314	6 999
February	8 219	7 737	5 390	4 630	9 658	6 528
March	8 024	7 899	5 399	5 015	10 284	6 138
April	8 047	7 318	5 397	5 106	9 731	6 334
May	8 030	7 485	5 023	5 403	10 134	7 064
June	7 712	7 065	4 479	5 198	8 415	6 645
July	7 207	6 838	4 329	5 704	8 168	5 940
August	7 057	6 763	4 084	6 452	8 010	5 525
September	7 321	6 507	4 106	7 031	8 642	5 030
October	7 034	6 383	3 875	7 325	7 683	4 828
November	6 946	6 142	4 135	7 953	7 344	5 082
December	6 584	5 949	3 881	8 087	7 319	5 268
			(converted to US$/lb)			
January	3.57	3.20	2.49	1.94	3.77	3.17
February	3.73	3.51	2.44	2.10	4.38	2.96
March	3.64	3.58	2.45	2.27	4.66	2.78
April	3.65	3.32	2.45	2.32	4.41	2.87
May	3.64	3.40	2.28	2.45	4.60	3.20
June	3.50	3.20	2.03	2.36	3.82	3.01
July	3.27	3.10	1.96	2.59	3.70	2.69
August	3.20	3.07	1.85	2.93	3.63	2.51
September	3.32	2.95	1.86	3.19	3.92	2.28
October	3.19	2.90	1.76	3.32	3.48	2.19
November	3.15	2.79	1.88	3.61	3.33	2.31
December	2.99	2.70	1.76	3.67	3.32	2.39

Source: INSG, various issues of *World Nickel Statistics* to April 2002.

TABLE 13. REFINED COBALT PRODUCTION, 1996-2001

Company	1996	1997	1998	1999	2000	2001
				(tonnes)		
PRODUCTION OF COMPANIES BELONGING TO THE COBALT DEVELOPMENT INSTITUTE						
OMG	4 160	5 000	5 250	6 200	7 700	8 100
Falconbridge	3 099	3 417	3 851	4 009	3 433	3 314
Gécamines	3 540	2 808	4 490	(b) 5 180	4 320	3 199
ICCI	2 070	2 250	2 640	2 770	2 855	2 943
Zambia (a)	4 799	3 949	5 011	3 946	(c) 2 316	(c) 2789
QNI		617	1 395	1 539	1 520	1 818
Murrin Murrin				83	925	1 452
Inco	1 544	1 500	1 740	1 420	1 470	1 450
CTT	80	220	241	470	1 200	1 200
Umicore (1)	1 200	1 200	1 200	950	1 110	1 090
Kasese				77	420	634
Sumitomo	228	263	329	221	311	350
Eramet	174	159	172	180	204	199
Subtotal	20 894	21 383	26 319	27 045	27 785	28 538
PRODUCTION OF OTHERS						
Mopani Copper					1 026	1 876
China	1 200	1 200	1 200	1 200	1 200	1 470
Brazil	193	266	364	630	792	889
South Africa	292	294	320	(e) 320	320	252
India		(e) 110	(e) 120	(e) 120	206	(e) 250
Bulong				79	192	203
Subtotal	1 685	1 870	2 004	2 349	3 736	4 940
EXPORTS AND SALES FROM STOCKPILES						
DLA sales	2 052	1 621	2 310	1 679	3082.6	1 893
Sales from other stocks	500					
C.I.S. exports	1 654	3 200	2 800	2 678	4 700	(e) 3 900
Subtotal	4 206	4 821	5 110	4 357	7 782.6	5 793
Total	26 785	28 074	33 433	33 751	39 303	39 271

Source: *Cobalt News,* 02/2, April 2002, The Cobalt Development Institute. Table re-arranged in order of descending production for 2001; data reproduced with permission of The Cobalt Development Institute.

"Refined cobalt" includes:

All cobalt units whether in metal or chemicals that are derived from feed requiring further refining.

The following materials are NOT counted as feed: DLA or other stockpile releases, Russian output, production from Likasi, and lower-grade production from Moroccan mines.

(a) Zambian production includes ZCCM, RAMZ, and Avmin.
(b) Revised to include Central Mining Group.
(c) Chambishi Metals plc production only.
(e) Estimate.
(1) Union Minière SA changed its name to Umicore.

ICCI = International Cobalt Company Inc. (marketed by Sherritt International Corporation)
OMG = OM Group, Inc.
CTT = Cie. de Tifnout-Tiranimine
DLA = Defense Logistics Agency
ZCCM = Zambia Consolidated Copper Limited
RAMZ = Roan Antelope Mining Corporation
Gécamines = La Générale des Carrières et des Mines
Mopani Copper = Mopani Copper Mines plc (a JV comprising the Mufilira mine/smelter/refinery plus the Nkana mine and cobalt plant)

Salt

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BRIEF HISTORICAL FACTS

The word "salt" comes from the Greek *halos*, and is commonly referred to as sodium chloride (NaCl).

Human history was shaped by the need for salt. Wars were fought over the possession of salt deposits. Salt bought slaves and at times was traded at twice the value of gold. Armies and civilians required salt to maintain health, preserve meat and tan leather. Salt became one of the world's first commodities. Each human being contains about four ounces of salt and, unless we get enough of it, our muscles won't contract, our blood won't circulate, our food won't digest and our hearts won't beat. The same is true for livestock; therefore, salt is important in diets.

Salt is such a common part of our everyday lives that we rarely think of it as a natural resource that must be discovered, boiled/evaporated or mined, processed, marketed and consumed. Accordingly, salt data and information are needed by the public and private sectors to better understand the use and ultimate disposition of minerals and materials in the economy and the environment, and to develop policies and practices that better use our mineral and material resources. The basic methods of salt production have not changed for centuries – only the woes surrounding it in meeting people's needs have changed.

In 2000, the top six salt-producing nations that collectively accounted for 55% of total world output (Table 3), in descending order of quantity produced, were the United States, China, Germany, India, Canada and Australia. In North America, some 57.5 Mt of salt were produced in 2000: 79.3% by the United States and 20.7% by Canada.

Canada exported close to 3.5 Mt of salt in 2000; 99.8% of this quantity was shipped to the United States. Canada also imports salt; it imported 1.14 Mt in 2000, 51.9% from the United States (Table 1). Canada's imports of salt from the United States represent close to 77% of the majority of U.S. exports of salt.[1]

Estimated world production of salt in 2000 was 214 Mt. The United States was the largest salt-producing nation, representing about 21.3% of total world output with 45.6 Mt. Canada's share was 5.6% of world production, or 11.9 Mt. The largest underground mine in North America is located in Goderich, Ontario.

On a per-capita basis, Canada is the largest consumer of salt in the world, and this is due mainly to its winter conditions. Most of the salt used as a de-icing agent is consumed in Ontario, Quebec and Atlantic Canada. The apparent domestic consumption is reflected as follows: chemical and de-icing uses account for between 90% and 95% while the remainder is used for water conditioning, food processing, fisheries, and other industrial uses.

Of the millions of tonnes of dry salt produced annually in North America, a very small percentage finds it way to family dining tables, either in commercially processed foods, in home preparations, or in the salt shaker. By far the biggest part of salt produced as brine and dry salt – approximately 70% – is used in the chemical industry. Directly or indirectly, salt plays a part in the manufacture of a seemingly endless list of chemicals and chemical products. For example, salt goes into the production of chlorine and into the manufacture of soda ash; in turn, these two products are used in the processing or manufacture of a wide variety of end products ranging from rayon, polyester and other synthetics to plastics for explosives, fertilizers, glass and cosmetics.

The salt markets in developed regions such as North America and Western Europe are mature and expanding at a rate a little below the average growth of the world economy. The main consuming regions are North America, Asia and the Middle East, and Western Europe. World salt consumption is on the rise, mainly in response to increasing demand in the countries of Southeast Asia and other developing nations.

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[1] Source: U.S. Geological Survey (USGS).

SUMMARY

Preliminary data indicate that Canadian salt shipments for 2001 were valued at $449.5 million, a $98 000 increase from 2000. This 2001 value reflects the cyclical production level from year to year in response to winter conditions. Imports were valued at almost $61.4 million for 2001, a $13.4 million increase from 2000. Preliminary exports for 2001 represented $116.2 million, an increase of $28.3 million from the previous 2000 value. Canadian exports are mainly sent to the United States while imports come primarily from the United States, Mexico and Chile. The provinces of Ontario, Quebec and British Columbia are the main destinations for these imports (Table 1).

Mined rock salt represents 83.6% of 2001 total shipments while brine represents 10.0% and fine vacuum salt represents 6.4%. Every year since 1980, exports have surpassed imports; the only exceptions to this trend were in 1989 and 1990 (Table 2).

PRICE

Due to the unavailability of prices from Canada's salt industry, the following price examples from other sources are provided. The May 2002 edition of *IM Magazine* reported that salt prices (ground rocksalt, 15-20 short ton lots, average price delivered U.K.) were in the range of £20-£30 (converted: $46.70-$70.00). As a basis of comparison for the North American market,[1] the salt produced has unique production, processing and packaging factors that determine the selling prices. Generally, salt sold in bulk is less expensive than salt that has been packaged, pelletized or pressed into blocks. Salt in brine is the least expensive salt sold because mining and processing costs are lower. Vacuum pan salt is the most expensive because of the higher energy cost involved in processing it and the purity of the product. Year 2000 average prices (net selling value, free on board plant, excluding container costs, U.S. dollars per metric ton) are as follows: bulk (vacuum pan and open pans, $50.58; rock, $21.16; brine, $5.70); compressed pellets (vacuum pan and open pans, $130.97; rock, n.a.; brine, n.a.); packaged (vacuum pan and open pans, $128.05; rock, $62.34; brine, n.a.); and pressed blocks (vacuum pan and open pans, $101.18; rock, $91.14; brine, n.a.). Canadian producers and others are well aware of the globalization factor affecting prices. A slight difference in price and usual orders made in previous years can be lost to a foreign competitor.

TRADE

Salt is a widespread, low-value, bulk commodity. It is relatively easy to extract and transportation represents a significant proportion of the total delivered price (one reason for imports into and exports from the United States and Canada for specific regions is the economic factor). As a consequence, international trade in salt is small relative to world production.

Canadian salt exports for 2001 went mostly to the United States (99.9%), an increase of 33% from 2000. Imports in Canada in 2001 came mainly from the United States, Mexico, Chile, the Bahamas, France, Japan, China and other countries. The United States provided 68.8% of the imports (Table 1).

CONSUMPTION

Chemical raw materials represent 60% of world salt consumption, followed by table salt (20%) and road de-icing salt (10%); the remaining 10% is used in animal feed and water treatment. Consumption patterns differ in North America.

Canada's high level of consumption, which at one time was estimated at over 360 kg of salt per person per year (consumption statistics were available until 1987), is due to severe winter conditions in many parts of the country and the use of salt to improve winter driving conditions.

The United States provides consumption details and these could be used to estimate the North American consumption of Canadian salt. In 2000, the U.S. distribution of salt by major end use was chemicals (42%), ice control (36%), distributors (grocery and other wholesalers and retailers) (7%), general industrial (6%), agricultural (4%), food processing (3%), primary water treatment (1%), and other uses (1%). For a more descriptive idea of the end-use industrial sector applications in these above categories, a paper was written in 1993 by Mr. Denis S. Kostick (USGS) titled *The Material Flow of Salt*, information circular #9343. One example in this report of the general industrial use of salt in the oil and gas exploration is described as follows: "Salt is an important component of drilling fluids in well drilling, since it is used to flocculate and to increase the density of the drilling fluid in order to overcome high down-well gas pressures. Whenever drilling activities encounter salt formations, salt is added to the drilling fluid to saturate the solution and minimize the dissolution within the salt strata. It is also used to increase the set rate of concrete in cemented casings."

The Canadian Salt Institute provides a web site with an explanation of the many uses of salt at the following address: www.saltinstitute.org/16.html.

The industrial chemicals indust [illegible] ource: NRCan) consumes salt for the manufacture of chloralkali such as caustic soda (sodium hydroxide), chlorine, and sodium chlorate. Salt for caustic soda and chlorine plants in Canada is obtained from on-site brining and natural brines; other plants used mined rock salt or imported solar or evaporated salt. Other industrial chemicals that require significant quantities of salt include sodium bicarbonate, sodium chlorite, sodium hypochlorite, sodium carbonate (soda ash), and calcium chloride.

Most pulp and paper mills in Canada have carried out extensive process modifications and improvements in effluent treatment. Several have opted to reduce chlorine usage by installing other bleaching processes such as extended lignification, oxygen delignification, sodium chlorate bleaching, integrated chlorine dioxide with hydrochloric acid recycling, and ozone and hydrogen peroxide bleaching processes. Although seen as a step in the right direction by environmentalists, they would prefer that the industry adopt dioxin-free bleaches such as oxygen and hydrogen peroxide.

Sodium chloride, or salt, remains the primary de-icing agent. Different de-icers are used in accordance with site requirements. Calcium chloride is the second most used de-icer, being effective at temperatures ranging between -10 and -20° C; this chemical is usually mixed with salt at a 2-4% rate. Growing concerns over the environment and the corrosion of infrastructure, such as bridge decks and parking lots, have led to numerous experiments with de-icing salt substitutes.

The effects of salt-spreading on the environment depend on a variety of factors such as weather conditions, road characteristics, traffic loads, winter maintenance methods, and local topography. Environmental effects may include adverse impacts on plant growth and crop productivity in the immediate vicinity of highways, as well as higher salinity levels in streams and groundwater systems. Because of its low price, de-icing salt is the favoured de-icing agent. The optimization of spreading rates, in combination with the search for adequate abrasive mixtures, will continue to be evaluated. For many years, provincial/territorial and regional agencies in charge of road maintenance have pursued the objective of optimizing the use and selection of ice and snow control methods. Cost, operational reliability, public safety and environmental issues must be considered and these agencies will continue to evaluate improvements to existing methods and better road safety and rideability.

Although the benefits of de-icing agents were recognized by the Environment Minister's Expert Advisory Panel on the Second Priority Substance List, the Panel recommended that they be assessed for potential impact on the environment but that "any measures developed as a result of the assessment must never compromise human safety." The overall conclusion of Environment Canada's *Canadian Environmental Protection Act, 1999* (CEPA 1999) report entitled *Priority Substances List Assessment* on road salts, is as follows: "Based on the available data . . . it is concluded that road salts that contain inorganic chloride salts with or without ferrocyanide salts are 'toxic' as defined in Section 64 . . ."

A working group that includes representatives of governments, industry, and environmental groups, met three times in 2002 to discuss best practices for the application, storage and disposal of road salt and to develop a guideline under CEPA 1999. The proposed control measures are expected to be published in the *Canada Gazette* in December 2003.

PRODUCTION

Canada has an abundant resource of salt. The vast Canadian territory has three known major salt formations, all of great area and thickness, in economically strategic locations. The largest deposits are in western Canada, followed by Ontario and the Atlantic provinces. In western Canada, the salt beds extend from the Northwest Territories down through Alberta, Saskatchewan and into Manitoba. This immense deposit, averaging 122 m (400 feet) in thickness and covering an area of approximately 390 000 km^2 (150 000 square miles), contains more than one million billion tonnes of salt.

In Ontario, salt is found along the shores of Lake Huron and Lake Erie. This deposit is part of the known Michigan Basin and is a saucer-shaped formation underlying part of Michigan, part of Ohio, and lakes Huron and Erie.

In the Atlantic provinces, large, thick deposits have been found underlying New Brunswick, Nova Scotia, part of Newfoundland and Labrador, and even the Gulf of Saint Lawrence. These deposits occurred in various geologic eras and all of them are the remains of ancient inland seas. The shorelines of these ancient seas, which outline the edges of the salt beds, mark the occurrences of the oil, gas and coal deposits that have been found in such abundance in Canada.

Major salt deposits and dry salt production in North America can be viewed at the following web site: www.saltinstitute.org/images/map.pdf.

The Canadian salt industry produces 13.5 Mt of salt from major rock salt mines in Ontario, Quebec and New Brunswick and from vacuum pan refineries in Alberta, Saskatchewan, Ontario, New Brunswick and Nova Scotia. Nearly three-quarters of this production was rock salt, used primarily for highway de-icing. In quantities produced, Canada ranks fifth in the world (Table 3). Two major methods are used to obtain salt from Canada's age-old deposits: underground room-and-pillar mining and brining. Recovery as a co-product of potash mining is also practised (Table 4). The most important Canadian producers are described below.

In **Nova Scotia**, The Canadian Salt Company Limited operates an underground rock salt mine at Pugwash in Cumberland County. Most of the salt from this mine is used for snow and ice control. It also operates an evaporated salt plant where saturated brine is fed to a quadruple-effect vacuum pan, where brine solution is evaporated to produce high-quality salt crystals for use in the chemical and food industries.

Sifto Canada Inc.'s (a subsidiary of Compass Minerals Group Inc.) production process in eastern Canada is a brining operation at the Amherst, Nova Scotia plant. Its vapour re-compression process produces an unequaled salt purity in North America and its evaporated salt products are sold for table salt, fisheries, and water conditioning.

In **New Brunswick**, Potash Corporation of Saskatchewan Inc. (New Brunswick Division) produces potash and salt at its underground mine near Sussex. It extracts salt and sells it mainly to the United States and eastern Canada. It also pumps brine back to the surface for re-use. This brine is produced from the clay slimes and excess brine slurries from the processing plant piped underground as backfill where rock salt has been extracted.

In **Quebec**, Seleine Mines Division (a subsidiary of The Canadian Salt Company Limited) is the only operating salt producer. It is located on the Magdalen Islands.

In **Ontario**, Sifto Canada Inc. operates an underground rock salt mine in Goderich Harbor on the shores of Lake Huron. It also operates an evaporating plant for brine production on the escarpment of the Maitland River. The products serve the home water softeners, packaged icemelts, agricultural salts, food processing, table salts, and industrial salts markets.

More commonly recognized under the leading consumer brand of Windsor, The Canadian Salt Company Limited is headquartered in Pointe-Claire, Quebec. It produces both rock salt from the Ojibway underground mine and vacuum salt from brine wells near Windsor. Salt products include de-icing road salt, and water softening, agricultural and chemical fine salt.

In **Saskatchewan**, Sifto Canada Inc. operates a brining operation near Unity for the production of fine vacuum pan salt, which is used for water softening, for agriculture and in food processing, as well as some de-icing salt for local use.

The Canadian Salt Company Limited at Belle-Plaine produces evaporated salt from by-product brines sourced from an adjacent potash solution mine operated by IMC Potash Belle Plaine, a subsidiary of IMC Kalium Canada Ltd. Most of the production goes towards water softening; other uses are for agriculture, food processing, and ice control.

In **Alberta**, The Canadian Salt Company Limited, at Lindberg, produces fine vacuum pan salt, which is also used for water softening, agriculture and food processing, as well as some de-icing salt for local use.

Other companies known to produce salt (mainly brine) are as follows:

- In Quebec, Junex, an oil and gas exploration company, has discovered a natural brine zone while drilling for gas in Bécancour. In 2001, Junex created Junex Solnat, which operates the natural brine operation. Its natural brine is sold as a dust control agent and ice removal products.

- In Saskatchewan, IMC Esterhazy Canada Limited Partnership (formerly known as International Minerals & Chemical Corporation [Canada] Global Limited) supplied by-product rock salt from its potash operation at Esterhazy to Kayway Salt, who is distributing it locally for road de-icing. Saskatoon Chemicals ("SaskChem," a subsidiary of Sterling Chemicals Holdings, Inc.) produces brines from wells near Saskatoon for the manufacture of caustic soda, chlorine and sodium chlorate to be used internally for its pulp chemicals operations. NSC Minerals Inc. in Rocanville, and also in Vanscoy, produces coarse and fine salt products from potash tailings.

- In Alberta, Dow Chemical Canada Inc. at Fort Saskatchewan near Edmonton extracts salt brines for the manufacture of chloralkali. Nexen Incorporated (formerly known as Canadian Occidental Petroleum Ltd. [Canadian OXY Ltd.]), and Albchem Industries Ltd. (where the plant site is located on the large and very pure Upper Lotsberg salt desposit), near Bruderheim, operate solution mines to produce sodium chlorate used mostly for pulp bleaching in the Prairie provinces and western Canada.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of September 30, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2501.00	Salt (including table salt and denatured salt) and pure sodium chloride, whether or not in aqueous solution or containing added anti-caking or free-flowing agents; sea water				
2501.00.10	Table salt made by an admixture of other ingredients when containing 90% or more of pure sodium chloride	2.5%	Free	Free	Free
2501.00.90	Other	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, SALT SHIPMENTS AND TRADE, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
SHIPMENTS							
	By type						
	Mined rock salt	10 004 167	274 744	9 458 260	253 876	11 331 585	338 639
	Fine vacuum salt	823 983	86 927	827 630	86 266	862 132	100 554
	Salt content of brines used or shipped	1 857 745	11 948	1 878 179	11 266	1 354 677	10 315
	Total	12 685 895	373 619	12 164 069	351 408	13 548 394	449 508
	By province						
	Nova Scotia	x	x	x	x	x	x
	New Brunswick	x	x	x	x	x	x
	Quebec	x	x	x	x	x	x
	Ontario	7 745 160	230 153	7 236 664	212 215	8 472 765	288 967
	Saskatchewan	754 992	33 485	756 958	33 650	798 120	38 400
	Alberta	1 286 729	21 544	1 310 891	19 554	1 231 725	19 782
	Total	12 685 895	373 619	12 164 069	351 408	13 548 394	449 508
IMPORTS							
2501.00	Salt (1)						
	United States	771 678	33 767	592 846	33 251	1 131 501	47 925
	Mexico	308 529	4 871	357 776	6 464	292 669	5 296
	Chile	257 672	6 987	146 827	4 415	129 431	4 613
	Bahamas	23 259	734	11 641	313	62 425	1 331
	France	3 511	406	2 892	321	7 786	806
	Japan	2 179	197	1 127	177	388	197
	China	381	154	664	133	3 648	154
	Other countries	8 423	894	27 896	2 935	16 273	1 094
	Total	1 375 633	48 012	1 141 669	48 009	1 644 121	61 416
	By province of clearance						
	Newfoundland and Labrador	23 066	721	11 712	327	24 211	717
	Nova Scotia	684	99	5	. . .	6 365	122
	New Brunswick	528	44	2 276	188	2 656	266
	Quebec	363 385	11 331	198 954	8 810	324 483	11 409
	Ontario	616 096	26 619	410 452	22 680	883 817	37 392
	Manitoba	7 108	761	12 715	886	12 149	773
	Saskatchewan	3 374	464	14 053	1 502	2 642	409
	Alberta	8 566	763	21 780	2 472	11 926	1 100
	British Columbia	352 826	7 210	469 721	11 144	375 870	9 228
	Total	1 375 633	48 012	1 141 669	48 009	1 644 119	61 416
EXPORTS							
2501.00	Salt (1)						
	United States	3 807 405	99 343	3 469 601	87 084	4 614 059	115 850
	Dominican Republic	616	163	3 516	377	1 397	103
	Hong Kong	–	–	9	5	25	49
	Other countries	72	33	2 629	389	25	49
	Total	3 808 093	99 539	3 475 755	87 855	4 616 725	116 153

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary; x Confidential.
(1) Includes table salt, pure sodium chloride and seawater salt.
Note: Numbers may not add to totals due to rounding.

TABLE 2. CANADA, SALT SHIPMENTS AND TRADE, 1980-2001

	Producers' Shipments					
	Mined Rock	Fine Vacuum	In Brine and Recovered in Chemical Operations	Total	Imports	Exports
			(tonnes)			
1980	4 507 416	781 428	2 134 010	7 422 854	1 151 203	1 637 601
1981	4 371 314	764 037	2 107 243	7 242 594	1 254 992	1 507 710
1982	5 223 073	773 086	1 944 172	7 940 331	1 526 879	1 721 893
1983	5 846 994	714 464	2 040 925	8 602 383	814 250	1 914 629
1984	7 030 664	754 675	2 450 060	10 235 399	1 053 217	2 530 038
1985	6 608 739	805 209	2 670 749	10 084 697	1 255 518	2 263 076
1986	6 867 287	815 044	2 649 515	10 331 846	1 328 298	2 502 518
1987	6 670 863	866 475	2 591 715	10 129 053	1 112 102	1 924 686
1988	7 126 762	783 368	2 777 050	10 687 180	1 202 219	3 030 124
1989	7 548 732	821 284	2 788 395	11 158 411	2 360 432	2 137 321
1990	7 704 499	778 428	2 708 458	11 191 385	2 095 321	1 897 816
1991	8 615 755	799 563	2 455 541	11 870 859	1 202 880	2 783 021
1992	7 912 989	770 370	2 404 667	11 088 026	1 041 424	2 650 921
1993	8 073 435	817 859	2 101 711	10 993 005	1 051 096	3 079 298
1994	9 446 002	822 181	1 975 704	12 243 887	940 131	3 638 674
1995	8 077 661	850 676	2 029 047	10 957 384	1 294 996	2 986 802
1996	9 499 189	853 858	1 895 430	12 248 477	1 137 604	3 816 788
1997	10 923 966	863 112	1 709 778	13 496 856	1 262 822	3 634 009
1998	10 517 641	834 944	1 681 710	13 034 295	977 944	4 177 880
1999	10 004 167	823 983	1 857 745	12 685 895	1 375 633	3 808 093
2000	9 458 260	827 630	1 878 179	12 164 069	1 141 669	3 475 755
2001 (p)	11 331 585	862 132	1 354 677	13 548 394	1 644 119	4 616 725

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary.

TABLE 3. WORLD SALT PRODUCTION, 1996-2001

	1996	1997	1998	1999	2000	2001 (e)
			(000 tonnes)			
United States (1)	42 300	(r) 41 500	(r) 41 300	45 000	45 600	45 100
China	(r) 29 035	(r) 30 830	(r) 22 420	28 124	31 300	32 000
Germany	15 907	(r) 15 787	(r) 15 700	15 700	15 700	15 800
India	(r) 14 486	(r) 14 251	(r) 11 964	14 453	14 500	14 500
Canada (2)	12 248	(r) 13 264	13 296	(r) 12 686	11 900	12 500
Mexico	8 508	7 933	(r) 8 412	(r) 8 236	8 900	8 600
Australia	7 905	(r) 8 801	(r) 8 879	10 003	8 800	8 000
France	7 860	(r) 7 085	(r) 7 000	7 000	7 000	7 100
Brazil	5 384	(r) 6 516	(r) 6 837	(r) 5 958	6 000	7 000
United Kingdom	6 610	6 600	6 600	5 800	5 800	5 700
Poland	4 163	(r) 3 859	(r) 4 005	(r) 4 212	4 200	4 500
Italy	(r) 3 541	(r) 3 510	3 600	3 600	3 600	3 600
Spain	4 000	4 000	(r) 3 500	3 200	3 200	3 300
Russia	2 100	2 100	(r) 2 200	(r) 3 200	3 200	3 000
Ukraine	2 800	2 500	2 500	(r) 2 185	2 300	2 400
Other countries	(r) 37 173	(r) 38 464	(r) 41 787	41 643	41 900	41 000
Total	(r) 204 000	(r) 207 000	(r) 200 000	(r) 211 000	214 000	214 000

Sources: Natural Resources Canada; U.S. Geological Survey.
(e) Estimated; (r) Revised.
(1) Excludes Puerto Rico. (2) The U.S. Geological Survey is the source for all data, excluding data for Canada, for which the source is Natural Resources Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADIAN SALT PRODUCERS, 2000-01

Company	Location/ Initial Production	Mill/Plant Capacity (t/d)	Remarks
Albchem Industries Ltd.	Virden, Man./2002	40 t/y	Brining to produce sodium chlorate.
	Bruderheim, Alta./1991	129	Brining to produce sodium chlorate. (Salt brine)
Nexen Chemicals Canada Limited Partnership	Bruderheim, Alta./1991	100	Brining to produce sodium chlorate. (Salt brine)
Canadian Salt Company Limited, The	Pugwash, N.S./1959	4 000	(Rock salt)
	Pugwash, N.S./1963	310	Brine made from mined rock salt used to produce fine evaporated salt. (Rock salt)
	Iles-de-la-Madeleine, Que./1982	4 800	(Rock salt)
	Ojibway, Ont./1955	10 300	Salt graded and prepared for markets. (Rock salt)
	Windsor, Ont./1892	681	Evaporated salt.
	Belle-Plaine, Sask./1969	650	Plant uses sodium chloride brines produced at the nearby potash solution mine of IMC Kalium Canada Ltd. (Evaporated salt)
	Lindbergh, Alta./1968	400	Produces coarse and fine salt. (Evaporated salt)
Dow Chemical Canada Inc.	Fort Saskatchewan, Alta/1967	3 500	Brining to produce caustic soda and chlorine. (Salt brine)
General Chemical Canada Ltd.	Amherstburg, Ont./1919	–	Brining to produce sodium carbonate and chloride. Discontinued operation in April 2001.
IMC Potash Belle Plaine, a subsidiary of IMC Kalium Canada Ltd.	Colonsay, Sask./1969	–	Various grades of salt are also produced. Discontinued operation in June 2001.
IMC Global Inc.	K1 mine, Esterhazy, Sask./1962	180 t/y	By-product rock salt from potash mine (standard, coarse and granular grades).
NSC Minerals Inc.	Rocanville, Sask./1990	200 t/y	Produces coarse and fine products. (Rock salt)
	Vanscoy, Sask./1988	300 t/y	Produces coarse and fine products. (Rock salt)
Potash Corporation of Saskatchewan Inc., New Brunswick Division	Sussex, N.B./1983	700 t/y	Three grades of muriate of potash (KCl) are produced from a flotation circuit and a crystallizer circuit. (Salt)
Sterling Pulp Chemicals (Sask) Ltd.	Saskatoon, Sask./1979	130	Primarily a manufacturer of pulp and water treatment chemicals. Brining to produce caustic soda, chlorine and sodium chlorate.
Sifto Canada Inc.	Amherst, Nappan, N.S./1947	312	Brining for vacuum pan evaporation. (Evaporated salt)
	Goderich, Ont./1959	26 000	Rock salt mining.
	Goderich, Ont./1872	326	Brining for vacuum pan evaporation. (Evaporated salt)
	Unity, Sask./1949	408	Brining for vacuum pan evaporation. (Evaporated salt)

Source: Natural Resources Canada, company surveys.

Silica

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SUMMARY

Preliminary data reported by users in Canada show that silica use was 2.8 Mt in 2000, a slight decrease of 129 090 t from the revised quantity of the previous year. Preliminary data reported by Canadian producers for 2001 indicate production was valued at $41.35 million, a $111 000 increase from 2000 (for which data were revised to $41.24 million from the NRCan published data on silica in 2000). Imports were valued at almost $108.2 million for 2001, a $5.3 million increase from 2000. Preliminary exports for 2001 represented close to $10.7 million, an increase of $3.8 million from the 2000 value of $6.9 million (Table 1).

In 2000, the increase in silica use was a result of increases in all major silica-using industry sectors, with the exception of the "primary glass and glass containers, and glass fibre wool" and "other products" sectors. The nonferrous smelting and refining industry, which represents 30.3% of the total use of silica in Canada, shows a preliminary increase of 11.7% from 1999. The primary glass and glass containers, and glass fibre wool sector, which represents 18.4% of total use, shows a decrease of 21.0% from 1999. Foundries, which represent 11.0% of the total use, show an increase of 21.4% from 1999. Chemicals, which represent 3.5% of total use, show an increase of 57.8% from 1999. The "other products" category, which includes a multitude of industry users, represents 36.8% of total silica use in Canada and shows a decrease of 10.5% from 1999 (Table 3).

With respect to the reported quantity of silica used by category, sand represents 61.0% of the total with barely an increase from 1999. For lump silica, which represents 35.2% of the total, a decrease of 12.4% from 1999 was observed, while flour, which represents 3.8% of the total, increased 12.5% (Table 4).

PRICES

Due to the unavailability of prices for Canada's silica industry, the following price examples from other sources are provided.

The May 2002 edition of *IM Magazine*, *#416* reported that silica sand prices (foundry sand, dry, bulk, ex-works) were in the range of £15.50-£16.50/t ($35.45-$37.74/t). The price range for the other categories (glass sand, flint, container, ex-works) was £15-£17/t (or $34.31-$38.88/t). Ex-works USA (foundry sand, dry, bulk) prices were in the range of $11.50-$25.00/t. Prices for actual transactions vary accordingly to geographic region and will take into account the quantity purchased, application, quality assurance, the exact grade purchased, credit terms, and other parameters.

U.S. prices (United States Geological Survey [USGS]), as an example, for the North American market, when compared with the average value of 1999 (i.e., the average value, free on board [f.o.b.] plant) of U.S. industrial sand and gravel,[1] increased by 4.7% to US$19.57/t in 2000. The average unit values for industrial sand and industrial gravel were US$19.87/t and $14.69/t, respectively. The average price for sand ranged from US$6.50/t for metallurgical flux to $114.62/t for ground fillers. For gravel, prices ranged from US$8.97/t for non-metallurgical flux to $23.36/t for filtration. U.S. producer prices reported to the USGS for silica commonly ranged from several dollars to hundreds of dollars per tonne and occasionally exceeded the US$1000/t level. In the United States, ground sand used as fillers for rubber, paint and putty had the highest value per tonne (US$114.62), followed by silica for swimming pool filters (US$68.29), ground sand for ceramics (US$51.94), ground sand for fibreglass (US$43.05), ground sand for scouring cleansers (US$37.47), refractory foundry sand (US$36.11), abrasives for sawing and sanding (US$35.56), and sand for hydraulic fracturing (US$34.75).

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[1] Different countries have different terminology and specifications for silica. In the United States, industrial sand and gravel is often called "silica," "silica sand" and "quartz sand," which includes sand and gravel with high silicon dioxide content.

TRADE

Although Canada is sufficient in silica production for its needs, it still imports the commodity to serve particular markets in regions where market conditions warrant this action. Imports for 2000 from the United States totaled 330 392 t (94.1%) of all imports (351 130 t) from all countries.

Imports from the United States come from loosely consolidated and easily processed sandstone or lake sand deposits located near the Great Lakes. Major U.S. operations are located in the states of Illinois, Wisconsin, Michigan and Indiana.

The bulk of imports (63.3%) from the United States is used by the Canadian iron and steel foundry industries and the Canadian glass manufacturing industries. Foundries imported 51.3% while the glass manufacturing industries imported 12.0% (Tables 1 and 2).

Preliminary data for 2001 indicate that Canada's exports of silica totaled 415 625 t, an increase of 5.4% over 2000. The value associated with this preliminary 2001 data ($10.7 million) shows an increase of 54.5% over the 2000 value ($6.9 million). This phenomenon is partly due to increases in the silicon dioxide category and in the quartz, silica sands and quartz sands categories (Table 1). Exports to the United States represented 85.7% of this preliminary total with the majority of those exports being silica sand and quartz sand.

PRODUCTION AND MARKET CONSIDERATIONS

The economics of the production and sale of the many types of silica are governed by many factors, but demand for silica is controlled mostly by the fortunes of the glass and foundries industries. Throughout North America, the silica sand industry is highly competitive on a regional basis and the industry is dominated by a few large producers. A silica sand source located substantially closer to its plant can save users hundreds of thousands of dollars per year by reducing transportation costs by only a few dollars per tonne. Lower-priced material is shipped only to local or regional markets. Beneficiation is the key to producing high-quality glass or foundry sand from most deposits.

As an example of market considerations, the demand for foundry sand (source: USGS) is dependent mainly on automotive and light truck production. In 2001, the U.S. slump in the auto sector (source: *Camford Chemical Report*) had a negative impact on rubber sales. The drop in North American rubber production reflects the decline in tire output (source: The Rubber Association of Canada). Canada's rubber processing industry mirrored U.S. economic conditions, although the Canadian auto market is rolling strong and has reached an all-time high of 1.57 million vehicles sold. This would explain why there was an increase in demand from 1999 to 2000 for foundry sand in Canada.

SUPPLY

The most important Canadian producers are described below.

The provinces of Quebec, Ontario and Alberta are the main producers of silica, followed by Saskatchewan, British Columbia and Nova Scotia.

In **Newfoundland and Labrador**, Shabogamo Mining and Exploration Co. Ltd. began mining its Roy's Knob quartzite deposit near Labrador City in October 1999. The company's washing and screening plant is located in Wabush, Labrador. The quartzite product is sent by rail to Sept-Îles, Quebec. Shabogamo has a contract to supply quartzite to Aluminerie de Bécancour Inc. of Quebec, which uses the material to manufacture silicon metal.

In **Nova Scotia**, Shaw Resources Ltd., a member of The Shaw Group Limited, produces a high-purity (98.5-99.5%) silica from sand deposits located near Shubenacadie. The silica is used mainly in sandblasting, as foundry sand and as filter sand. In addition, fine sand from its silica operation is beneficiated to flint glass-grade material. Fine sand products are sold in the Maritimes, Quebec and northeastern United States for use in sandblasting, filter sand, traction sand, cement and concrete manufacturing, refractory and decorative sand, and as a flux for base-metal smelters; the sand could also be used in glass-making.

In **New Brunswick**, Shaw Resources, Chaleur Silica – a division of The Shaw Group Limited, manufactures abrasive products using raw material from Nova Scotia, Ontario and the United States. The company also produces silica for use as a flux at the Belledune lead smelter and for use in cement manufacture.

Atlantic Silica Inc. mines a high-grade (+98%) silica deposit near Sussex for use in sandblasting, silicon metal, silicon carbide, foundry sand, filtration sand and ornamental sand. Most of it is used in eastern Canada although some is shipped to the United States.

In **Quebec**, Unimin Canada Ltd., a subsidiary of Unimin Corp. of the United States, is the largest producer of silica. Silica is mined from a quartzite deposit at Saint-Donat-de-Montcalm and from a sandstone deposit at Saint-Canut. Silica from Saint-

Donat is shipped and refined at the Saint-Canut plant near Montréal. Most of the silica produced by Unimin originates from Saint-Canut where the ore is ground, screened and beneficiated by magnetic separation. Most of Unimin's output is used in the production of glass containers, flat glass and fibreglass, and also in the silicon carbide industries.

Bécancour Chemical Industries operates the silica plant in Bécancour. It also owns the quartzite deposit north of La Mabaie that is being developed by Sitec Inc.

Sitec Inc. is a joint venture between Baskatong Quartz Inc., which produces high-purity quartz, and SOQUEM INC., a wholly owned subsidiary of SGF Minéral inc.

La Compagnie Bon Sable Ltée mines silica sand at Saint-Joseph-du-Lac and Ormstown. The material is used mainly for sandblasting and as concrete sand; it is also suitable for the production of fibreglass.

Silco Sands Inc. mines and grinds its silica at its plant in Sainte-Clotide-de-Châteauguay. The products are sold to a chemical company, a cement plant and a ferromanganese plant.

Temisca inc., which was recently sold to Stake Technology Ltd. (StakeTech) of Norval, Ontario, mines and processes silica near Saint-Bruno-de-Guigues. Temisca supplies the golf course, filtration, frac, abrasives and construction markets. The processing facility includes a 200 000-t/y hydrosizer and screening, drying and packaging equipment.

Other significant producers include Silco Sands Inc., with a silica sandstone quarry in Sainte-Clotide-de-Châteauguay; Béton provincial ltée, with a silica sandstone quarry in Gaspé's Larivière County; and Société Minière Gerdin Inc., in Saint-Rémi-d'Amherst, with a silica sand quarry.

In **Ontario**, Unimin Canada Ltd. is also the largest producer of silica with a reported capacity of about 500 000 t/y. Lump quartzite from Badgeley Island (150 000-t/y capacity) in northern Georgian Bay is shipped by lake boat to Canadian destinations for the manufacture of ferrosilicon. The finer material, produced by grinding, is shipped to Unimin's plant at Midland (400 000-t/y capacity), south of Georgian Bay, where it is further processed to a glass-grade silica sand and silica flour for ceramic and other uses.

Other significant producers include Arriscraft International Inc. with its Elgin Quarry, Damron Minerals with its Ellis Quarry, Great White Minerals Ltd. with its Fripp Quarry, Inco Limited with its Lawson Quarry, and Hunt Engineering Group with its Penhorwood and Roseval quarries.

In **Manitoba** there are no silica quarries currently in operation.

In **Saskatchewan**, Hudson Bay Mining and Smelting Co., Limited (HBMS) produces silica in the Amisk Lake area of northern Saskatchewan and is the largest user of the province's silica sand at its Flin Flon, Manitoba, smelter. HBMS uses sand as a fluxing agent which, in the molten state, reacts with various impurities in the copper and zinc ore to produce a slag. The slag is produced in the smelter where the impurities are drawn off, leaving a more refined metal behind.

Red Deer Silica Inc. produces a small amount of silica, northeast of the village of Hudson Bay, for use in golf course bunkers, stucco sand and sandblasting sand.

Hanson Lake Sand Corp. (HLSC), a wholly owned subsidiary of Daren Industries Ltd. of Vancouver, British Columbia, has doubled its capacity to transport silica from its mining/processing operations to its distribution facility in Prince Albert. As a result, the company will be able to increase its shipments of Canadian White frac sand to the Alberta market.

In **Alberta**, Sil Industrial Minerals Inc. of Edmonton produces silica sand from local sand dunes in the Bruderheim area. It also operates a silica processing facility near Edmonton. The silica is sold mainly for the manufacture of fibreglass and as sandblasting material. Other uses include foundry sand, filtration sand, fracturing sand and railway traction sand. The company also produces silica flour by processing the silica sand through a ball mill; the flour is used in thermal insulating cement in the oil and gas industries.

United Industrial Services Ltd. (UIS) of Calgary, Alberta, owns a silica mine and a processing plant in Peace River that began production in 1999. Customers for the silica include the foundry, fibreglass and frac sand industries. In June 2001, UIS and its subsidiaries, Alberta Silica Corp. and Alberta Silica Mining Corp., were ordered into receivership. The business is continuing to operate with a skeleton staff and the intent is to sell it as a going concern.

In **British Columbia**, the Mountain Minerals Division of Highwood Resources Ltd., in Calgary, Alberta, mines a high-purity (99.5%) silica sand for diverse industrial applications (e.g., glass grade) at the Moberley mine in the Golden area. The friable sandstone is ground, screened, washed, dried and separated into several sizes at a plant near Golden. These different sizes are sold mainly as glass sand, but also as sandblasting sand, foundry sand, filter media sand and golf course sand. In addition, the Division produces lump silica for use in the production of silicon.

Monteith Bay Resources Ltd. produces silica sand at its Monteith Bay quarry on Western Vancouver Island.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of July 15, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2804.61	Silicon containing by weight not less than 99.99% of silicon	Free	Free	Free	Free
2804.69	Silicon, n.e.s.	5%	3%	3%	Free
2811.22	Silicon dioxide	Free	Free	Free	Free
2849.20	Silicon carbide	Free	Free	Free	Free
7202.21.10	Ferro-silicon containing by weight more than 55% but less than 60% of silicon	Free	Free	Free	Free
7202.21.20	Ferrosilicon containing by weight 60% or more of silicon but less than 90%	Free	Free	Free	Free
7202.21.30	Ferro-silicon containing by weight 90% or more of silicon	Free	Free	Free	Free
7202.29	Ferro-silicon, n.e.s.	Free	Free	Free	Free
7202.3	Ferro-silico-manganese	Free	Free	Free	Free
7202.5	Ferro-silico-chromium	Free	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.
n.e.s. Not elsewhere specified.

TABLE 1. SILICA, CANADIAN PRODUCTION AND TRADE, 2000 AND 2001

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION (shipments)					
	By province				
	Newfoundland and Labrador	x	x	x	x
	Nova Scotia	x	x	x	x
	New Brunswick	x	x	x	x
	Quebec	522 049	13 363	534 000	13 411
	Ontario	427 989	10 444	475 540	10 565
	Manitoba	x	x	x	x
	Alberta	261 664	8 453	261 664	8 453
	British Columbia	x	x	x	x
	Total	1 508 490	41 239	1 567 306	41 350
IMPORTS (1)					
2505.10	Silica sands and quartz sands				
	United States	312 325	44 812	289 827	46 758
	China	544	505	687	852
	Germany	1 461	804	726	516
	South Africa	1 448	410	1 503	423
	Australia	226	224	446	376
	Other countries	1 610	725	1 538	646
	Total	317 614	47 480	294 727	49 571
2506.10	Quartz (other than natural sands)				
	United States	18 828	1 052	16 512	755
	Brazil	5 213	220	4 514	251
	Germany	1 134	62	2 316	132
	Japan	–	–	152	11
	Other countries	20 856	882	33	1
	Total	46 031	2 216	23 557	1 152
2506.21	Quartzite, crude or roughly trimmed				
	United States	949	211	1 302	253
	Brazil	–	–	20	4
	Other countries	20	6	11	–
	Total	969	217	1 333	257
2506.29	Quartzite n.e.s.				
	Japan	503	41	1 648	112
	United States	2 094	136	1 318	83
	Brazil	8	. . .	922	55
	Other countries	128	11	493	20
	Total	2 733	188	4 381	270
2811.22	Silicon dioxide				
	United States	21 588	41 102	21 433	40 830
	Germany	1 633	7 647	1 526	7 508
	Other countries	1 675	3 962	4 173	8 563
	Total	24 896	52 711	27 132	56 901
	Total imports	392 243	102 812	351 130	108 151

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS					
2505.10	Silica sands and quartz sands				
	United States	370 528	4 740	350 095	5 620
	Norway	9 567	318	19 006	666
	Venezuela	260	55	2 735	145
	Other countries	147	52	23 752	116
	Total	380 502	5 165	395 588	6 547
2506.10	Quartz (other than natural sands)				
	United States	1 708	459	4 974	1 881
	Bulgaria	538	35	2 142	136
	Cuba	–	–	213	24
	Japan	–	–	28	4
	Taiwan	508	28	–	–
	Total	2 754	522	7 357	2 045
2506.21	Quartzite, crude or roughly trimmed				
	Norway	10 250	520	11 294	565
	United States	673	263	845	323
	Total	10 923	783	12 139	888
2506.29	Quartzite n.e.s.				
	Cuba	–	–	93	9
	United States	180	69	–	–
	Philippines	–	–	–	–
	Total	180	69	93	9
2811.22	Silicon dioxide				
	United States	90	340	159	714
	Hong Kong	–	–	76	344
	Other countries	50	39	213	141
	Total	140	379	448	1 199
	Total exports	394 499	6 918	415 625	10 688

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
(1) Includes sand for use in foundries and glass manufacturing, ground and flour sand, and volatized and silica flue dust.
Note: Numbers may not add to totals due to rounding.

TABLE 2. IMPORTS OF SILICA SAND FROM THE UNITED STATES, BY PROVINCE AND BY USE, 2000 AND 2001

	2000		2001 (p)	
	(tonnes)	($000)	(tonnes)	($000)
FOUNDRY				
Nova Scotia	1 000	18 467	461	20 327
New Brunswick	121	8 186	20 671	874 989
Quebec	26 408	616 885	95 332	8 653 771
Ontario	101 215	10 826 747	22 200	882 475
Manitoba	26 717	1 098 726	116	30 385
Saskatchewan	220	87 481	26 316	1 303 040
Alberta	26 910	1 044 663	4 381	320 133
British Columbia	5 733	370 293	114	71 560
Total	188 324	14 071 448	169 591	12 156 680
GLASS MANUFACTURING				
Nova Scotia	298	95 326	12	2 431
Quebec	646	136 138	213	73 291
Ontario	62 768	2 173 250	38 460	1 950 140
Manitoba	6	3 275	24	985
Alberta	758	28 545	857	46 861
British Columbia	72	59 782	77	45 297
Total	64 548	2 496 316	39 643	2 119 005

Source: Statistics Canada.
(p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 3. REPORTED USE[(1)] OF SILICA IN CANADA, BY INDUSTRY, 1999 AND 2000

	1999	2000 (p)
	(tonnes)	
Nonferrous smelting and refining	(r) 771 900	862 584
Primary glass and glass containers, and glass fibre wool	662 046	523 021
Foundries	305 858	312 400
Chemicals	62 498	98 649
Other products (2)	1 170 806	1 047 364
Total	(r) 2 973 108	2 844 018

Source: Natural Resources Canada.
(p) Preliminary; (r) Revised.
(1) Available data, as reported by users. (2) Includes asbestos products, asphalt roofing products, cement, ceramic products, structural clay products, cleansers, fertilizers, paint and varnish, pulp and paper products, refractory brick, rubber products, ferroalloys, primary steel, and other miscellaneous products.

TABLE 4. SILICA, REPORTED QUANTITY USED(1) IN CANADA, 1999 AND 2000(p)

	1999	2000 (p)
	(tonnes)	
Sand	(r) 1 732 848	1 733 853
Lump	1 144 408	1 002 303
Flour	95 852	107 862
Total	(r) 2 973 108	2 844 018

Source: Natural Resources Canada.

(p) Preliminary; (r) Revised.

(1) Available data, as reported by users.

Stone

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The volume of all types of stone shipped in Canada in 2001 was approximately 120 Mt based on preliminary figures. This amount is about 1% higher than in 2000. The reported value of total shipments in 2001 was about $884 million, essentially the same as the previous year. Shipments served a very wide range of uses related to dimension stone, chemical and metallurgical grades of stone, pulverized stone, and crushed stone, as shown in Table 2, which follows the trade data summarized in Table 1.

Shipments of crushed stone (mainly chemical-grade limestone) for producing cement, as well as lime, are essentially accounted for in separate chapters entitled "Cement" and "Lime." Additional detailed information on regular aggregates, including crushed stone and sand and gravel, as well as on lightweight aggregates, is included in a separate chapter entitled "Mineral Aggregates." The lightweight aggregates included are: expanded shales/clays, perlite, vermiculite, pumice, and expanded ferrous slags or granules.

Dimension or ornamental stone relates to a variety of rock types that can be cut, shaped or simply selected for a broad range of construction/engineering, architectural or monumental requirements. The types of stone available are dependent on local geology, but mainly include granite, limestone, marble, sandstone and slate, as summarized in Tables 3 to 8 inclusive. The term "granite," as commercially applied, includes true granite, granodiorite, gneiss, and other medium- to coarse-grained igneous rocks. However, "black granite" includes anorthosite and other dark-coloured igneous rocks. Limestone and marble are often confused, marble being the metamorphosed equivalent of the former and usually including both dolomitic and calcitic varieties. As an industrial term, "marble" refers to recrystallized calcareous rock capable of taking a polish.

Recent developments in the dimension stone industry in Canada include: 1) the start-up of a $20 million gang saw processing plant for granite in Argentia, Newfoundland and Labrador; 2) construction of a dimension stone plant to produce monuments and custom products in Hopedale, Labrador; and 3) continued expansion in shipments of processed granite, particularly from British Columbia.

Plant modernizations by several stone producers across Canada have increased the availability of high-quality finished products at competitive prices. Major trends in exports of dimension stone during the period 1997-2001 have been: 1) an approximately 50% increase in the value of exports of rough granite and worked building and monumental granite combined from Quebec (about $97 million in 2001); 2) a doubling in the value of exports of equivalent dimension stone products from British Columbia (nearly $9 million in 2001); and a near doubling in the value of exports of rough and worked stone products from Ontario, mainly relating to calcareous stone, granite, and other worked stone (about $21 million in 2001).

It is expected that growth in the use of dimension stone in Canada will moderate in 2002, based mainly on a slowdown in non-residential construction, including office buildings. Similarly, exports of rough stone and fabricated stone products are expected to be weaker based on a slowdown in building construction in U.S. markets. Slate is becoming more important in world markets for its natural unpolished appearance, its non-slippery and multi-coloured durable surfaces, and its relatively low price.

Additional information on the Canadian stone industry can be found at provincial government web sites relating to natural resources (accessible through Natural Resources Canada's Internet site at www.nrcan.gc.ca/mms/prov-e.htm).

Also, the commercial names related to many rough and finished stone products can be found at the Canadian Stone Association's (CSA) web site at www.stone.ca.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of February 1, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

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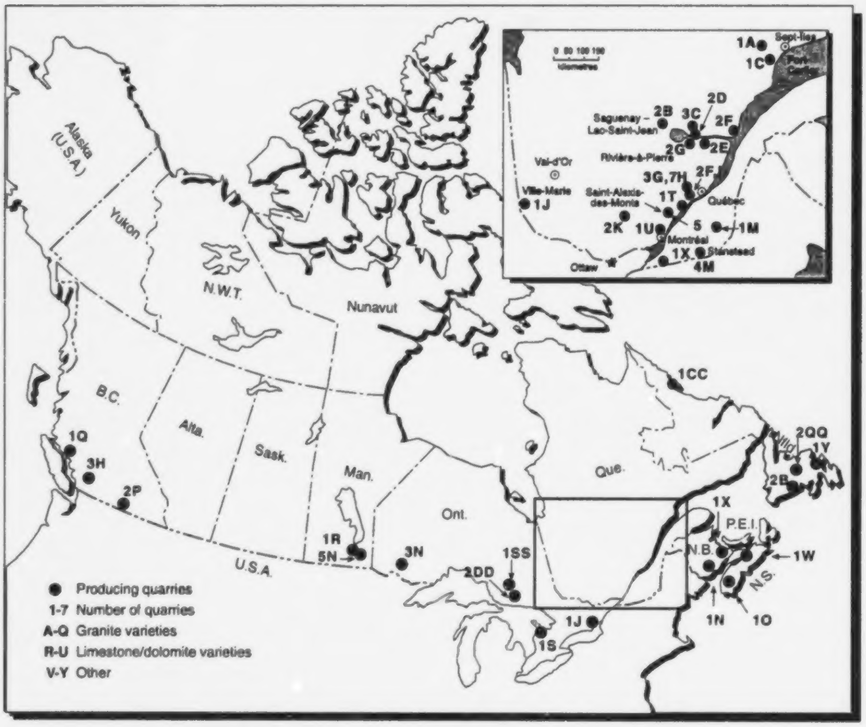
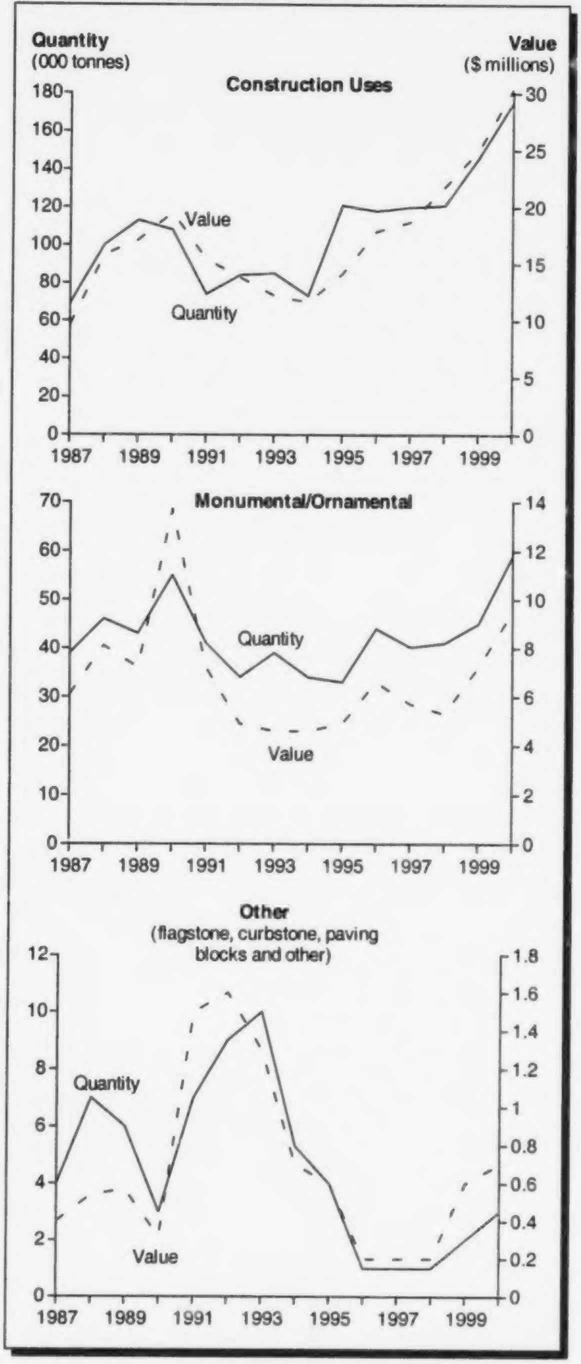
Figure 1
Canada, Architectural and Monumental/Ornamental Stone-Producing Centres, 2000


Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld
P.E.I.
N.B.
N.S.
U.S.A.
1Q
3H
2P
1R
5N
3N
2DD
1SS
1S
1J
1CC
2QQ
1Y
2B
1X
1W
1N
1O
0 50 100 150
Kilometres
1A
Sept-Îles
1C
Port-Cartier
2D
Saguenay – Lac-Saint-Jean
2B
3C
2F
2G
2E
Rivière-à-Pierre
Val-d'Or
3G,7H
2F
Ville-Marie
1J
Saint-Alexis-des-Monts
1T
Québec
2K
1U
5
1M
Montréal
1X
Stanstead
4M
Ottaw
● Producing quarries
1-7 Number of quarries
A-Q Granite varieties
R-U Limestone/dolomite varieties
V-Y Other

A	Fine-grained pinkish-grey banded gneiss
B	Medium-grained pink granite
C	Coarse-grained black anorthosite
CC	Medium-grained "Reflect blue" anorthosite
D	Medium-grained black gabbroic anorthosite
DD	Blue-grey, and black and white anorthosite
E	Medium-grained pinkish-grey quartz monzonite
F	Fine-grained pink granitic gneiss
G	Coarse-grained green charnockite
H	Coarse-grained pink-grey or brown-grey granite
I	Medium-grained grey dioritic gneiss
J	Medium-grained red granite
K	Fine-grained pink aplite
L	Coarse-grained brown or red quartz monzonite
M	Medium-grained grey granite
N	Medium-grained pink, brown or gold granites
O	Fine-grained blue-grey granite
P	Coarse coral pink granite
Q	Medium-grained blue-grey granite
QQ	Medium-grained gabbro
R	Light-coloured mottled dolomitic limestone (Tyndall)
S	Fine-medium crystalline blue-grey to buff marble/dolostone (Arriscraft)
SS	Fine-grained, multicoloured pre-Cambrian marble
T	Medium-grained light brownish-grey limestone (Deschambault)
U	Medium-grained blue-grey limestone (Chazy)
V	Medium-grained olive sandstone
W	Fine-medium-grained olive-brown and blue-grey sandstone
X	Fine-medium-grained white to buff sandstone (Potsdam)
Y	Very fine-grained varicoloured slate

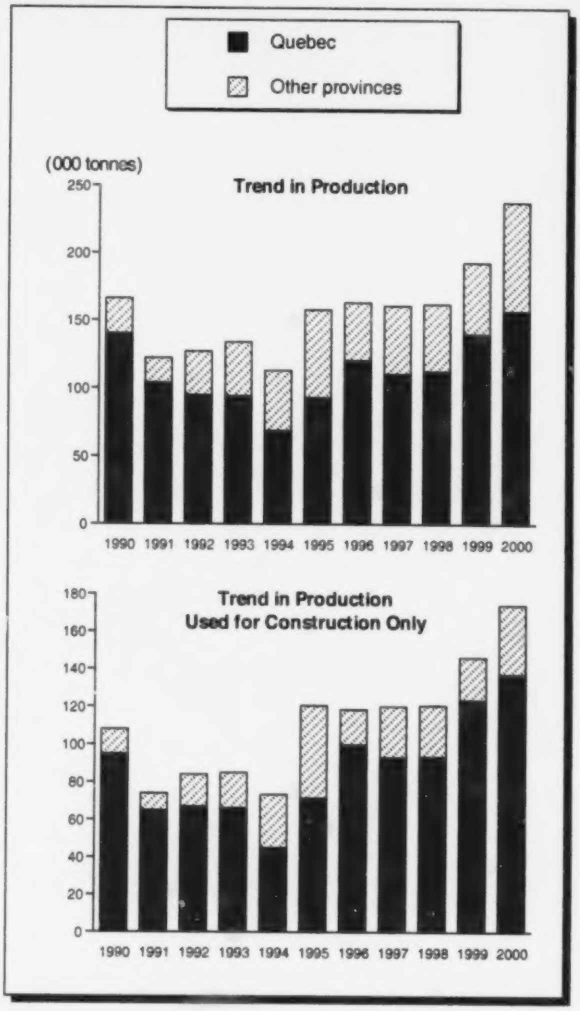
Source: Mainly provincial departments of Mines and Energy.

Figure 2
Canada, Production of Rough Granite (Sold and Used by Producers), 1987-2000



Sources: Natural Resources Canada; Statistics Canada.

Figure 3
Canada, Trends in Production of Rough Dimensional Granite for Construction, Monumental/Ornamental and Other Uses, 1990-2000



Sources: Natural Resources Canada; Quebec Ministry of Natural Resources.

TARIFFS

		Canada			United States
Item No.	Description	MFN	GPT	USA	Canada
2514.00	Slate, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
2514.00.10	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.50%	Free	Free	Free
2514.00.90	Other	Free	Free	Free	Free
25.15	Marble, travertine, ecaussine and other calcareous monumental or building stone of an apparent specific gravity of 2.5 or more, and alabaster, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Marble and travertine:				
2515.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2515.12.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free	Free	Free	Free
2515.20	Ecaussine and other calcareous monumental or building stone; alabaster				
2515.20.10	Crude or roughly trimmed	Free	Free	Free	Free
2515.20.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.16	Granite, porphyry, basalt, sandstone and other monumental or building stone, whether or not roughly trimmed or merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape				
	Granite:				
2516.11.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.12	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	Free-3.5%	Free	Free	Free
	Sandstone:				
2516.21.00	Crude or roughly trimmed	Free	Free	Free	Free
2516.22.00	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
2516.90	Other monumental or building stone				
2516.90.10	Crude or roughly trimmed	Free	Free	Free	Free
2516.90.20	Merely cut, by sawing or otherwise, into blocks or slabs of a rectangular (including square) shape	3.5%	Free	Free	Free
25.17	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates, for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated; macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in the first part of the heading; tarred macadam, granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated				
2517.10.00	Pebbles, gravel, broken or crushed stone, of a kind commonly used for concrete aggregates for road metalling or for railway or other ballast, shingle and flint, whether or not heat-treated	Free	Free	Free	Free

TARIFFS (cont'd)

Item No.	Description	Canada			United States
		MFN	GPT	USA	Canada
2517.20.00	Macadam of slag, dross or similar industrial waste, whether or not incorporating the materials cited in subheading no. 2517.10	Free	Free	Free	Free
2517.30.00	Tarred macadam	6.5%	Free	Free	Free
	Granules, chippings and powder, of stones of heading nos. 25.15 or 25.16, whether or not heat-treated:				
2517.41.00	Of marble	Free	Free	Free	Free
2517.49	Other				
2517.49.10	Limestone, roofing granules	Free	Free	Free	Free
2517.49.90	Other	Free	Free	Free	Free
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	3.5%	Free	Free	Free
68.02	Worked monumental or building stone (except slate) and articles thereof, other than goods of heading no. 68.01; mosaic cubes and the like, of natural stone (including slate), whether or not on a backing; artificially coloured granules, chippings and powder, of natural stone (including slate)				
6802.10	Tiles, cubes and similar articles, whether or not rectangular (including square), the largest surface area of which is capable of being enclosed in a square that is less than 7 cm; artificially coloured granules, chippings and powder				
6802.10.10	Roofing granules, artificially coloured	Free	Free	Free	Free
6802.10.90	Other	8%	5%	Free	Free
	Other monumental or building stone and articles thereof, simply cut or sawn, with a flat or even surface:				
6802.21.00	Marble, travertine and alabaster	3.5%	Free	Free	Free
6802.22.00	Other calcareous stone	5%	Free	Free	Free
6802.23.00	Granite	3.5%	Free	Free	Free
6802.29.00	Other stone	5%	Free	Free	Free
	Other:				
6802.91.00	Marble, travertine and alabaster	6%	Free	Free	Free
6802.92.00	Other calcareous stone	6.5%	3%	Free	Free
6802.93.00	Granite	6.5%	6.5%	Free	Free
6802.99.00	Other stone	6.5%	6.5%	Free	Free
6803.00	Worked slate and articles of slate or of agglomerated slate				
6803.00.10	Roofing slate; slate for use in the manufacture of billard tables	Free	Free	Free	Free
6803.00.90	Other	6.5%	6.5%	Free	Free
68.04	Millstones, grindstones, grinding wheels and the like, without frameworks, for grinding, sharpening, polishing, trueing or cutting, hand sharpening or polishing stones, and parts thereof, of natural stone, of agglomerated natural or artificial abrasives, or of ceramics, with or without parts of other				
6804.10.00	Millstones and grindstones for milling, grinding or pulping	6.5%	Free	Free	Free
6804.23.00	Of natural stone	6.5%	Free	Free	Free

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002.

TABLE 1. CANADA, STONE EXPORTS AND IMPORTS, 1999-2001

Item No.		1999		2000		2001 (p)	
		(t)	($000)	(t)	($000)	(t)	($000)
EXPORTS							
2514.00	Slate, whether or not roughly trimmed or merely cut, etc.	84	129	271	137	357	252
2515.11	Marble and travertine, crude or roughly trimmed	60	43	4	4	5	14
2515.12	Marble and travertine, merely cut, by sawing or otherwise, into blocks, etc.	403	193	633	440	604	358
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.11	Granite, crude or roughly trimmed	25 763	14 056	28 260	13 163	31 527	13 156
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.12	Granite, merely cut, by sawing or otherwise, into blocks, etc.	4 126	2 431	19 379	6 248	25 592	6 832
		(cubic metres)		**(cubic metres)**		**(cubic metres)**	
2516.21	Sandstone, crude or roughly trimmed	30	4	15	13	45	91
		(tonnes)		**(tonnes)**		**(tonnes)**	
2516.22	Sandstone, merely cut, by sawing or otherwise, into blocks, etc.	96	56	118	56	338	194
2516.90	Monumental or building stone, n.e.s.	4 467	1 091	3 151	806	3 176	1 067
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.	3 358 128	35 245	3 776 891	35 450	4 911 787	49 130
2517.41	Marble granules, chipping and powder of 25.15 or 25.16, heat-treated or not	267 194	37 958	347 873	56 015	49 078	8 983
2517.49	Granules, chippings and powder, n.e.s. of 25.15 or 25.16, heat-treated or not	41 155	1 139	100 853	6 103	35 520	1 269
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	..	1 467	..	1 631	..	2 496
6802.10	Tiles, etc., rectangular or square not more than 7 cm, etc., artificially coloured	..	5 541	..	35 739	..	41 932
6802.21	Monumental or building stone, cut or sawn, flat or even, marble, travertine and alabaster	..	171	..	39	..	687
6802.22	Monumental or building stone, cut or sawn, flat or even, other calcareous stone	..	102	..	73	..	647
6802.23	Monumental or building stone, cut or sawn, flat or even, granite	..	3 099	..	1 903	..	4 145
6802.29	Monumental or building stone, cut or sawn, flat or even, n.e.s.	..	2 089	..	901	..	1 169
6802.91	Worked monumental or building stone, n.e.s., marble, travertine or alabaster	..	2 330	..	1 403	..	2 051
6802.92	Worked monumental or building stone, n.e.s., calcareous stone, n.e.s.	..	1 649	..	4 196	..	8 948
6802.93.10	Worked building stone of granite	..	21 338	..	26 407	..	20 585
6802.93.90	Worked monumental or building stone, n.e.s., granite	..	35 672	..	38 690	..	43 692
6802.99	Worked monumental or building stone, n.e.s.	..	33 542	..	31 566		40 048
6803.00	Worked slate and articles of slate or agglomerated slate	..	7 840	..	11 148	..	6 371
6804.1	Millstones and grindstones for milling, grinding or pulping	..	4 927	..	4 292	..	5 233
6804.23	Millstones, grindstones, etc., of natural stone	..	1 104	..	538	..	438
	Total exports	..	213 216	..	277 242	..	259 788

TABLE 1 (cont'd)

Item No.		1999		2000		2001 (p)	
		(t)	($000)	(t)	($000)	(t)	($000)
IMPORTS							
2514.00	Slate, whether or not roughly trimmed or merely cut, etc.	2 731	1 279	4 298	2 080	6 353	3 388
2515.11	Marble and travertine, crude or roughly trimmed	1 760	851	1 627	810	2 157	927
2515.12	Marble and travertine, merely cut, by sawing or otherwise, into blocks, etc.	1 293	866	1 432	978	1 278	1 060
2516.11	Granite, crude or roughly trimmed	64 938	20 044	62 018	18 336	81 433	24 144
2516.12	Granite, merely cut, by sawing or otherwise, into blocks, etc.	3 833	3 106	3 961	3 468	4 034	3 719
2516.21	Sandstone, crude or roughly trimmed	7 184	803	6 002	625	11 847	1 573
2516.22	Sandstone, merely cut, by sawing or otherwise, into blocks, etc.	5 306	1 671	5 268	1 749	5 010	1 758
2516.90	Monumental or building stone, n.e.s.	5 440	1 555	98 879	3 108	8 539	3 520
2517.10	Pebbles, gravel, broken or crushed stone used for aggregates, etc.	3 188 098	17 887	3 125 368	17 315	3 164 978	17 061
2517.41	Marble granules, chipping and powder of 25.15 or 25.16, heat-treated or not	88 644	15 250	59 153	10 424	73 414	15 562
2517.49	Granules, chippings and powder, n.e.s. of 25.15 or 25.16, heat-treated or not	26 569	1 399	29 944	1 724	27 859	1 691
6801.00	Setts, curbstones and flagstones of natural stone (except slate)	. .	392	. .	436	. .	713
6802.10	Tiles, etc., rectangular or square not more than 7 cm, etc., artificially coloured granules, chippings and powder	. .	642	. .	795	. .	557
6802.21	Monumental or building stone, cut or sawn, flat or even, marble, travertine and alabaster	. .	10 737	. .	11 248	. .	11 877
6802.22	Monumental or building stone, cut or sawn, flat or even, other calcareous stone	. .	349	. .	252	. .	637
6802.23.00.10	Granite, cut or sawn flat or even, bulding stone	4 713	5 903	5 550	6 692	5 691	7 090
6802.23.00.20	Granite, cut or sawn flat or even, monumental	481	405	629	769	693	759
6802.23.00.90	Granite, cut or sawn flat or even, granite other	7 759	12 140	10 256	14 317	10 964	16 317
6802.29	Monumental or building stone, cut or sawn, flat or even, n.e.s.	. .	2 094	. .	2 381	. .	2 661
6802.91	Worked monumental or building stone, n.e.s., marble, travertine or alabaster	. .	19 945	. .	20 367	. .	25 927
6802.92	Worked monumental or building stone, n.e.s., calcareous stone, n.e.s.	. .	1 493	. .	2 530	. .	5 299
6802.93.00.10	Worked building stone of granite	1 878	3 257	1 357	2 028	1 383	2 402
6802.93.00.20	Worked monumental stone of granite, monuments, bases and markets finished	2 014	2 769	2 269	3 601	3 606	5 509
6802.93.00.90	Worked monumental or building stone, n.e.s., granite	5 055	7 098	5 510	8 501	6 402	9 941
6802.99	Worked monumental or building stone, n.e.s.	. .	2 755	. .	3 223	. .	3 170
6803.00	Worked slate and articles of slate or agglomerated slate	. .	6 278	. .	8 000	. .	8 199
6804.10	Millstones and grindstones for milling, grinding or pulping	. .	2 068	. .	2 492	. .	2 608
6804.23	Millstones, grindstones, etc., of natural stone	. .	1 041	. .	842	. .	1 106
	Total imports	. .	144 026	. .	149 423	. .	179 175

Source: Statistics Canada.
. . Not available or not applicable; n.e.s. Not elsewhere specified; (p) Preliminary.

TABLE 2. CANADA, TOTAL PRODUCTION OF STONE, 1999-2001

Item No.	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	3 091	20 206	4 505	27 859	3 794	27 677
Nova Scotia	7 881	48 064	8 379	51 246	8 413	51 949
New Brunswick	4 388	23 141	3 294	19 429	4 003	17 201
Quebec	30 269	218 744	31 550	229 984	32 508	240 411
Ontario	51 258	385 675	58 704	474 155	59 861	471 779
Manitoba	4 314	20 089	4 007	19 688	3 424	17 092
Saskatchewan	–	–	x	x	x	x
Alberta	465	4 623	x	x	x	x
British Columbia	7 440	54 505	6 636	49 172	6 663	47 923
Northwest Territories	78	452	186	2 952	187	2 535
Total	109 184	775 499	118 222	881 260	119 805	884 081
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	315	41 031	360	50 388	. .	. .
Monumental and ornamental stone (n.f.)	88	7 939	111	10 598	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	104	13 550	105	16 311	. .	. .
Total dimension stone	507	62 520	576	77 297	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	20 718	122 299	21 830	131 073	. .	. .
Asphalt aggregate	11 097	69 608	11 509	72 753	. .	. .
Road metal	30 663	165 040	36 478	192 907	. .	. .
Railroad ballast (includes traprock)	1 830	15 437	1 681	14 375	. .	. .
Other uses	34 873	181 907	36 061	201 603	. .	. .
Chemical and metallurgical						
Cement plants, Canada	14 082	50 085	14 776	44 570	. .	. .
Cement plants, foreign	525	1 919	539	2 273	. .	. .
Flux in iron and steel furnaces	1 295	10 476	680	6 279	. .	. .
Flux in nonferrous smelters	101	818	100	1 519	. .	. .
Glass factories	163	2 739	51	738	. .	. .
Lime plants, Canada	5 261	19 877	3 184	19 513	. .	. .
Lime plants, foreign	1 229	6 269	1 437	8 586	. .	. .
Pulp and paper mills	96	1 120	118	1 271	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	1 550	9 360	1 763	12 777	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	3	120	2	68	. .	. .
Roofing granules	751	27 309	873	37 348	. .	. .
Poultry grit	176	1 775	173	1 427	. .	. .
Stucco dash	25	2 682	23	3 985	. .	. .
Terrazzo chips	7	303	9	666	. .	. .
Rock wool	26	424	25	431	. .	. .
Rubble and riprap	942	4 415	1 257	4 476	. .	. .
Other uses	1 090	8 506	1 562	8 245	. .	. .
Pulverized stone						
Whiting	274	9 956	44	3 971	. .	. .
Asphalt filler	178	247	200	363	. .	. .
Dusting coal mines	2	145	1	51	. .	. .
Agricultural purposes and fertilizer plants	1 049	15 377	1 113	18 500	. .	. .
Other uses	897	58 632	1 064	82 428	. .	. .
Total crushed stone	128 903	786 848	136 554	872 196	. .	. .
Total all stone	129 410	849 368	137 130	949 493	. .	. .

Source: Natural Resources Canada.

– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary.

(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) Data include stone used in the Canadian cement, lime and clay industries.

Note: Numbers may not add to totals due to rounding.

TABLE 3. CANADA, PRODUCTION OF LIMESTONE, 1999-2001

	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (1)						
Newfoundland and Labrador	1 965	12 318	2 259	14 580	1 874	10 925
Nova Scotia	172	x	200	x	156	x
New Brunswick	601	x	652	x	481	x
Quebec	21 262	121 681	22 886	131 367	25 057	151 687
Ontario	48 164	287 460	55 355	333 780	55 678	350 106
Manitoba	3 823	15 614	3 548	15 136	2 967	13 967
Saskatchewan	–	–	x	x	x	x
Alberta	449	2 739	x	x	x	x
British Columbia	2 691	27 233	3 025	25 212	3 042	23 917
Northwest Territories	39	x	69	x	49	x
Total	79 165	475 758	88 941	534 596	90 241	563 971
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	84	6 852	81	7 214	. .	. .
Monumental and ornamental stone (n.f.)	34	512	45	811	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	67	4 708	69	6 679	. .	. .
Total dimension stone	185	12 072	195	14 704	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	16 313	97 286	18 569	109 303	. .	. .
Asphalt aggregate	6 268	38 211	6 761	39 980	. .	. .
Road metal	23 980	129 970	29 433	157 038	. .	. .
Railroad ballast (includes traprock)	136	969	86	475	. .	. .
Other uses	25 338	130 307	27 281	148 938	. .	. .
Chemical and metallurgical						
Cement plants, Canada	13 336	47 054	13 943	41 244	. .	. .
Cement plants, foreign	467	1 655	482	2 014	. .	. .
Flux in iron and steel furnaces	1 295	10 476	680	6 279	. .	. .
Flux in nonferrous smelters	101	818	39	684	. .	. .
Glass factories	137	1 971	51	738	. .	. .
Lime plants, Canada	5 261	19 877	3 184	19 513	. .	. .
Lime plants, foreign	1 229	6 269	1 437	8 586	. .	. .
Pulp and paper mills	96	1 120	118	1 271	. .	. .
Sugar refineries	–	–	–	–	. .	. .
Other chemical uses	522	4 573	928	9 710	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	130	764	103	623	. .	. .
Poultry grit	175	1 679	172	1 351	. .	. .
Stucco dash	24	2 604	22	3 822	. .	. .
Rock wool	3	19	2	11	. .	. .
Rubble and riprap	533	2 184	725	2 341	. .	. .
Other uses	805	6 610	752	6 013	. .	. .
Pulverized stone						
Whiting	271	9 878	44	3 971	. .	. .
Asphalt filler	50	185	68	299	. .	. .
Dusting, coal mines	2	145	1	51	. .	. .
Agricultural purposes and fertilizer plants	972	13 162	1 046	16 152	. .	. .
Other uses	133	2 829	78	1 477	. .	. .
Total crushed stone	97 577	530 617	106 007	581 883	. .	. .
Total all stone	97 762	542 689	106 202	596 587	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Data exclude stone used in the Canadian cement and lime industries. (2) Data include stone used in the Canadian cement and lime industries.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, PRODUCTION OF MARBLE,(1) 1999-2001

	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE						
Quebec	605	x	612	x	493	x
Ontario	683	x	757	x	714	x
British Columbia	–	–	1	x	–	–
Total	1 288	66 358	1 370	93 217	1 207	72 378
BY USE						
Stone (Dimension)						
Dimension stone						
Rough	15	543	19	1 071	. .	. .
Monumental and ornamental stone (n.f.)	–	–	1	104	. .	. .
Other (flagstone, curbstone, paving, blocks, etc.)	13	1 740	11	1 738	. .	. .
Total dimension stone	28	2 283	31	2 913	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	164	1 826	202	2 134	. .	. .
Asphalt aggregate	23	137	3	18	. .	. .
Road metal	34	162	62	295	. .	. .
Other uses	141	1 391	124	3 112	. .	. .
Chemical process stone						
Flux in nonferrous smelters	–	–	4	131		
Glass factories	27	768	–	–	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	2	60	2	68	. .	. .
Roofing granules	28	756	30	804	. .	. .
Poultry grit	. . .	3	–	–	. .	. .
Stucco dash	1	23	1	100	. .	. .
Terrazzo chips	7	303	9	666	. .	. .
Rock wool	–	–	–	–	. .	. .
Rubble and riprap	–	–	–	–	. .	. .
Other uses	11	717	11	694	. .	. .
Pulverized stone						
Agricultural purposes and fertilizer plants	77	2 215	67	2 349	. .	. .
Other uses	746	55 715	802	79 742	. .	. .
Total crushed stone	1 260	64 075	1 317	90 113	. .	. .
Total all stone	1 288	66 358	1 348	93 026	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Marble refers to a commercial definition that may also include limestone, travertine and greenstone (serpentinite or amphibole).
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA, PRODUCTION OF GRANITE, 1999-2001

	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY						
Newfoundland and Labrador	326	4 516	1 053	8 753	1 103	10 511
Nova Scotia	6 506	38 796	6 736	40 356	6 808	41 000
New Brunswick	3 450	15 655	2 279	9 967	3 359	11 221
Quebec	5 560	55 314	5 486	57 404	5 357	52 965
Ontario	2 389	x	2 546	x	3 435	x
Manitoba	344	x	326	x	288	x
British Columbia	4 673	x	3 544	x	3 550	x
Northwest Territories	29	x	84	x	122	x
Total	23 276	191 334	22 054	204 794	24 024	205 107
BY USE						
Stone (Dimension)						
Dimension stone						
Rough	146	24 977	175	30 252	..	..
Monumental and ornamental stone (n.f.)	45	7 232	59	9 509	..	..
Other (flagstone, curbstone, paving blocks, etc.)	2	595	3	721	..	..
Total dimension stone	193	32 804	238	40 481	..	..
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	3 813	21 159	2 818	18 245	..	..
Asphalt aggregate	4 334	27 670	4 310	29 692	..	..
Road metal	4 594	25 717	5 190	28 091	..	..
Railroad ballast (includes traprock)	1 553	13 883	1 510	13 582	..	..
Other uses	7 586	40 932	6 093	35 456	..	..
Chemical process stone						
Cements plants, Canada	–	–	30	210		
Miscellaneous stone						
Manufacture of artificial stone	1	60	–	–	..	..
Roofing granules	594	25 789	730	35 803	..	..
Poultry grit	1	93	1	75	..	..
Stucco dash	...	56	...	63	..	..
Rock wool	23	404	23	421	..	..
Rubble and riprap	299	1 798	288	1 533	..	..
Other uses	139	817	703	1 236	..	..
Pulverized stone						
Asphalt filler	128	62	132	64	..	..
Other uses	18	89	18	90	..	..
Total crushed stone	23 083	158 530	21 846	164 562	..	..
Total all stone	23 276	191 334	22 084	205 043	..	..

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
Notes: Numbers may not add to totals due to rounding. Data include shipments by producers regardless of industrial classification. Granite may include other igneous rocks (e.g., basaltic roofing granules).

TABLE 6. CANADA, PRODUCTION OF SANDSTONE, 1999-2001

	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE (1)						
Newfoundland and Labrador	794	3 349	1 035	4 036	726	2 959
Nova Scotia	1 179	6 338	1 418	7 732	1 428	7 903
New Brunswick	. . .	x	68	x	65	x
Quebec	2 171	15 606	2 351	18 860	1 384	13 384
Ontario	14	2 287	18	2 451	24	2 408
Manitoba	1	x	1	x	–	–
British Columbia	–	–	18	x	18	x
Total	4 160	27 591	4 910	34 150	3 646	27 078
BY USE (2)						
Stone (Dimension)						
Dimension stone						
Rough	47	5 880	58	8 535	. .	. .
Monumental and ornamental stone (n.f.)	8	196	6	174	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	10	695	7	532	. .	. .
Total dimension stone	65	6 771	72	9 241	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	428	2 028	241	1 391	. .	. .
Asphalt aggregate	471	3 590	425	3 043	. .	. .
Road metal	1 441	6 614	1 486	6 647	. .	. .
Railroad ballast (includes traprock)	141	585	85	318	. .	. .
Other uses	1 298	6 414	2 073	10 717	. .	. .
Chemical process stone						
Cement plants, Canada	217	1 251	141	816	. .	. .
Cement plants, foreign	–	–	18	98	. .	. .
Flux in nonferrous smelters	–	–	56	704	. .	. .
Other chemical uses	145	880	–	–	. .	. .
Miscellaneous stone						
Manufacture of artificial stone	–	–	–	–	. .	. .
Roofing granules	–	–	10	118	. .	. .
Rubble and riprap	110	432	242	600	. .	. .
Other uses	58	200	36	154	. .	. .
Pulverized stone						
Whiting	3	78	–	–	. .	. .
Other uses	–	–	165	1 119	. .	. .
Total crushed stone	4 312	22 071	4 979	25 725	. .	. .
Total all stone	4 377	28 842	5 051	34 965	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; . . . Amount too small to be expressed; n.f. Not finished or dressed; (p) Preliminary; x Confidential.
(1) Data exclude stone used in the Canadian cement industry. (2) Data include stone used in the Canadian cement industry.
Note: Numbers may not add to totals due to rounding.

TABLE 7. CANADA, PRODUCTION OF SHALE,(1) 1999-2001

	1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
BY PROVINCE/TERRITORY (2)						
Newfoundland and Labrador	6	24	158	490	91	3 281
Nova Scotia	24	x	24	x	20	x
New Brunswick	336	x	295	x	97	x
Quebec	671	x	214	x	217	x
Ontario	7	896	28	1 279	9	937
Manitoba	147	99	132	79	168	112
Alberta	16	x	15	x	16	x
British Columbia	76	464	48	313	53	410
Northwest Territories	10	x	33	x	16	x
Total	1 294	14 457	948	14 504	687	15 548
BY USE (3)						
Stone (Dimension)						
Dimension stone						
Rough	23	2 780	26	3 317	. .	. .
Other (flagstone, curbstone, paving blocks, etc.)	11	5 812	15	6 641	. .	. .
Total dimension stone	34	8 592	41	9 958	. .	. .
Stone (Crushed)						
Crushed stone for						
Concrete aggregate	–	–	–	–	. .	. .
Asphalt aggregate	–	–	10	20	. .	. .
Road metal	614	2 577	308	836	. .	. .
Other uses	510	2 863	490	3 381	. .	. .
Chemical process stone						
Cement plants, Canada	529	1 781	662	2 301	. .	. .
Cement plants, foreign	59	264	38	160		
Other chemical uses	883	3 907	835	3 067	. .	. .
Miscellaneous stone						
Rubble and riprap	–	–	1	1	. .	. .
Other uses	77	162	60	148	. .	. .
Total crushed stone	2 673	11 552	2 404	9 914	. .	. .
Total all stone	2 707	20 144	2 445	19 872	. .	. .

Source: Natural Resources Canada.
– Nil; . . Not available; (p) Preliminary; x Confidential.
(1) May include slate. (2) Data exclude stone used in the Canadian cement and clay industries. (3) Data include stone used in the Canadian cement and clay industries.
Note: Numbers may not add to totals due to rounding.

TABLE 8. CANADA, PRODUCTION OF STONE BY TYPE,[1] 1985, 1990 AND 1999-2001

	1985		1990		1999		2000		2001 (p)	
	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)	(000 t)	($000)
Granite	17 219	95 424	19 524	147 048	23 276	191 334	22 054	204 794	24 024	205 107
Limestone	77 874	317 862	86 519	470 649	79 165	475 758	88 941	534 596	90 241	563 971
Marble	571	13 966	771	19 555	1 288	66 358	1 370	93 217	1 207	72 378
Sandstone	3 011	15 310	2 975	20 534	4 160	27 591	4 910	34 150	3 646	27 078
Shale (2)	1 561	3 059	1 566	5 169	1 294	14 457	948	14 504	687	15 548
Total	100 236	445 622	111 355	663 254	109 184	775 499	118 222	881 260	119 805	884 081

Source: Natural Resources Canada.
(p) Preliminary.
(1) Data exclude stone used in the Canadian cement, lime and clay industries. (2) May include slate.
Note: Numbers may not add to totals due to rounding.

TABLE 9. CANADA, ROUGH GRANITE, SUMMARY OF PRODUCTION AND TRADE, 1985-2001

	Quantity Value	Production (1)	Imports (2)	Exports (2)
1985	t	104 000	34 468	(a) 12 511
	$ millions	12.8	6.2	1.7
1986	t	121 000	33 994	(a) 18 450
	$ millions	15.7	6.6	2.7
1987	t	112 000	46 370	(a) 37 450
	$ millions	16.1	7.9	6.0
1988	t	153 000	46 282	86 940
	$ millions	24.4	11.2	(r) 16.2
1989	t	162 000	52 337	107 105
	$ millions	24.8	11.7	17.3
1990	t	166 000	46 149	(r) 79 640
	$ millions	33.6	11.2	(r) 19.8
1991	t	122 000	35 038	(r) 91 630
	$ millions	24.0	8.5	22.6
1992	t	127 000	44 951	(r) 94 530
	$ millions	20.3	10.5	21.4
1993	t	134 000	41 484	(r) 88 830
	$ millions	18.1	10.8	20.3
1994	t	112 000	35 619	(r) 95 000
	$ millions	16.9	10.1	20.0
1995	t	158 000	41 099	(r) 94 200
	$ millions	19.6	11.4	17.9
1996	t	163 000	53 543	(r) 97 700
	$ millions	24.6	15.4	20.9
1997	t	161000	54 639	(r) 80 194
	$ millions	24.5	16.0	16.4
1998	t	163 000	75 186	(r) 69 937
	$ millions	27.3	23.0	15.1
1999	t	193 000	68 770	(r) 73 687
	$ millions	32.8	23.2	16.5
2000	t	238 000	65 979	(r) 95 680
	$ millions	40.5	21.8	19.4
2001	t	(e) 250 000	85 467	(r) 110 715
	$ millions	42.0	27.9	20.0

Sources: Natural Resources Canada; Statistics Canada.
(e) Estimated; (r) Assumes a factor of 2.7 for converting cubic metres to tonnes.
(a) Coded as building stone, rough (90% is considered to be granite).
(1) Includes rough stone for construction, monumental/ornamental and other uses.
(2) Includes codes 2516.11 (roughly trimmed block) and 2516.12 (cut block by sawing or otherwise). Some re-exports to the United States may also be involved.

Uranium

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OVERVIEW

Uranium producers continued to face challenging market conditions in 2001 as abundant secondary supplies continued to compete for limited demand. However, energy shortages in California, coupled with an increasing focus on clean air and climate change, stimulated a public debate on energy policy that produced a generally more favourable attitude toward nuclear power. These events may translate into improved market conditions for uranium producers over the next few years.

Against this background, spot market prices recovered from a near record low at the end of 2000, rising generally during 2001 and ending the year 34% higher than they started. Canadian uranium producers remain well positioned to capitalize on any additional market upturn as the transition to new production centres tapping high-grade, low-cost deposits in northern Saskatchewan is successfully proceeding.

Canadian uranium production in 2001 amounted to a record total of 12 522 tU, up some 17% from the 2000 total due to increased contributions from the McArthur River and McClean Lake mines. As Figure 1 shows, the world's two largest uranium-producing companies have operations in Canada. As of January 1, 2002, Canada's total "known" recoverable uranium resources totalled 452 000 tU, compared with 437 000 tU as of January 1, 2001. This upward adjustment of some 3% is the result of ongoing deposit appraisal.

Despite low prices, Canadian uranium production capability continues to expand in the province of Saskatchewan. The McClean Lake mill increased its licensed production capacity by some 33% (to 3077 tU). The McArthur River mine continued to ramp up to its annual licensed production capacity of 6900 tU, producing 6639 tU in 2001. A feasibility study was approved and a detailed engineering plan was initiated for the Cigar Lake mine in 2001 with production currently expected to begin as early as 2005.

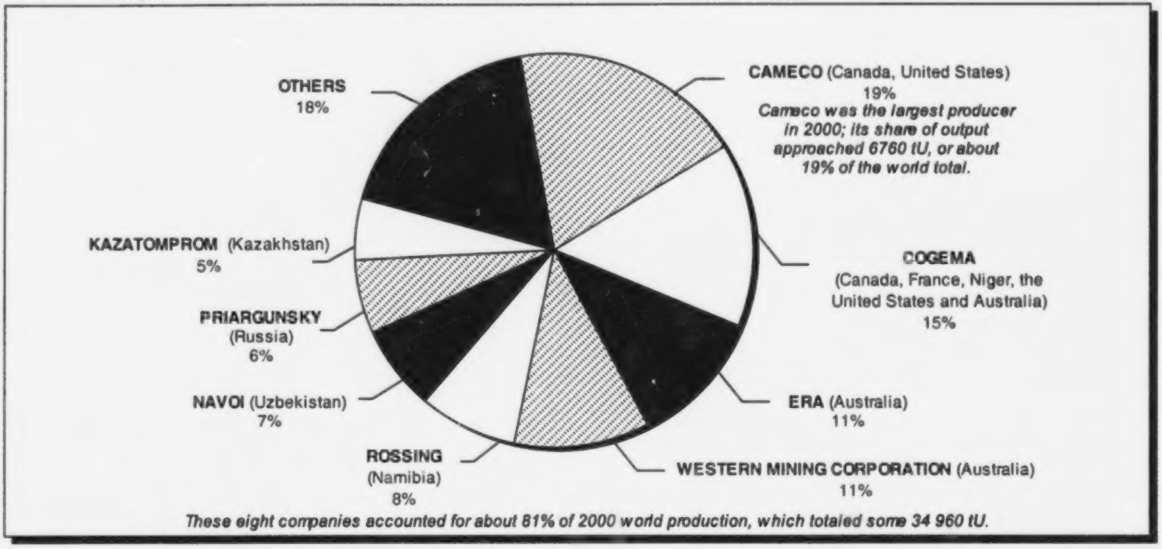
DOMESTIC PRODUCTION AND DEVELOPMENTS

In 2000, the most recent year with complete data available, production amounted to 10 683 tU, a sharp increase of 35% from the 1999 total. This increase is the result of contributions from the new McArthur River and McClean Lake production centres. Overall employment in Canada's uranium mining industry remained slightly above 1000 in 2000 (Table 1). Shipments from mining centres decreased slightly in 2000, compared to 1999, and the value of the shipments declined as well (Table 2). These data primarily reflect the successful transition uranium producers are making to new high-grade production centres as resources near depletion at older production centres. With increased 2000 production, uranium continues to rank among Canada's top 10 metal commodities in terms of output value. Table 3 documents the main operational characteristics of the existing uranium production centres in Canada in 2000, and Table 4 updates the status of new projects that represent Canada's future production capability. Although current production and new projects are centred in the Athabasca basin of northern Saskatchewan, one prospective property, Kiggavik, is located in Nunavut (Figure 2). Uranium production in Canada in 2000 (Figure 3) was dominated by Cameco Corporation and COGEMA Resources Inc. (CRI).

On March 18, 2001, Billiton Plc and BHP Limited merged to become Australian-based BHP Billiton, one of the world's largest producers of minerals and metals. The merger followed Billiton's October 2000 purchase of Rio Algom Limited, a Toronto-based mining company that operated uranium mines in Elliot Lake, Ontario.

On September 1, 2001, Mr. T. Gitzel was appointed President and Chief Executive Officer of CRI, replacing Mr. A. de Bourayne, who became Head of

Figure 1
World s Top Uranium Mining Companies in 2000



Source: *World Nuclear Association Pocket Guide.*
Note: Ranking reflects equity interest in production facilities, not market share.

COGEMA S.A.'s Enrichment Business Unit and Chairman of EURODIF Production Company. Later that same month, the AREVA Group was created through the amalgamation of CRI's parent company, COGEMA S.A., with FRAMATOME Advanced Nuclear Power and FCI Electronics.

On February 14, 2002, Crown Investments Corporation of Saskatchewan sold its remaining 10% ownership in Cameco for $226.4 million. The only remaining government stake in the company is one Class B share, owned by the Government of Saskatchewan, that entitles it to vote separately as a class with respect to any proposal to locate Cameco's head office outside the province of Saskatchewan.

Cameco was formed in 1988 through the merger of the Saskatchewan Mining Development Corporation and the federal Crown corporation, Eldorado Nuclear Limited. Since then, the two levels of government have gradually reduced their share holdings. The Government of Canada divested its last remaining shares in Cameco in 1995.

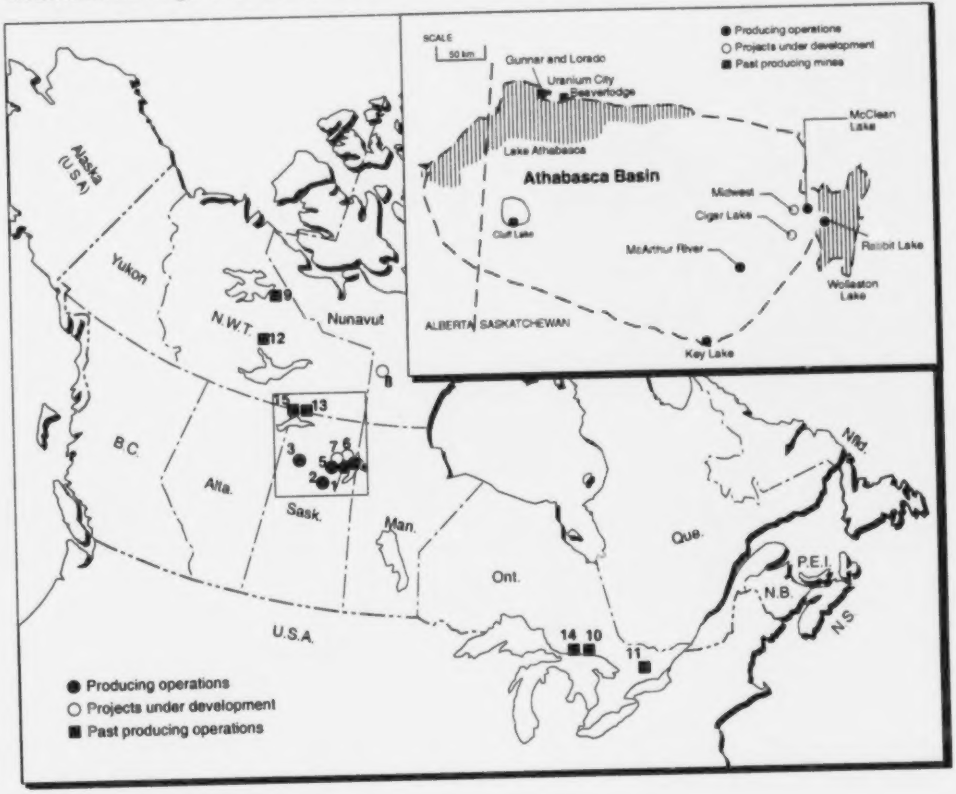
Elliot Lake, Ontario

Elliot Lake, Ontario, was a major uranium mining centre in Canada for several decades. Since the last facility closed in 1996, Rio Algom and Denison Mines Limited have committed over $75 million to decommission their mine and mill sites. Following an environmental assessment and receipt of government approvals and licences from regulatory agencies, buildings were dismantled and waste management areas were stabilized and contained. Some tailings areas were flooded to control radon emissions and acid generation. All major reclamation work was completed in the late 1990s.

The Serpent River Watershed Monitoring Program was initiated to gauge the recovery of the watershed that hosted the mining. Sample collections are designed to assess water quality, sediment quality, benthic community health, and fish health, as well as radiation and metal doses to humans and wildlife utilizing the watershed. Data collected in 1999 from 20 lakes and 28 streams both upstream and downstream from the mine sites show that the impact of mining is discernable, mainly in the form of above background levels of salts, total dissolved solids and some metals. However, with rare exceptions, measured concentrations are within projected levels and the fish, benthic invertebrates and wildlife are displaying no adverse effects. The monitoring program is slated to continue on a five-year cycle.

Some of the older waste sites (containing principally uranium mine tailings) in the Elliot Lake area were not flooded but were stabilized by vegetation to control dust and surface run-off. Run-off and seepage from these sites are collected for treatment. Of these older sites, Rio Algom's Spanish American, Milliken, Lacnor, Nordic/Buckles and Pronto sites are not presently licensed by the Canadian Nuclear Safety

Figure 2
Uranium Mining in Canada, 2001


SCALE
50 km
Gunnar and Lorado
Uranium City
Beaverlodge
● Producing operations
○ Projects under development
■ Past producing mines
McClean Lake
Lake Athabasca
Athabasca Basin
Midwest
Cigar Lake
Cluff Lake
McArthur River
Rabbit Lake
Wollaston Lake
ALBERTA SASKATCHEWAN
Key Lake
Alaska (U.S.A.)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
3
5
6
7
8
9
10
11
12
13
14
15
● Producing operations
○ Projects under development
■ Past producing operations

Numbers refer to locations on map above

PRODUCING OPERATIONS

1. Rabbit Lake
2. Key Lake
3. Cluff Lake
4. McClean Lake
5. McArthur River

PROJECTS UNDER DEVELOPMENT

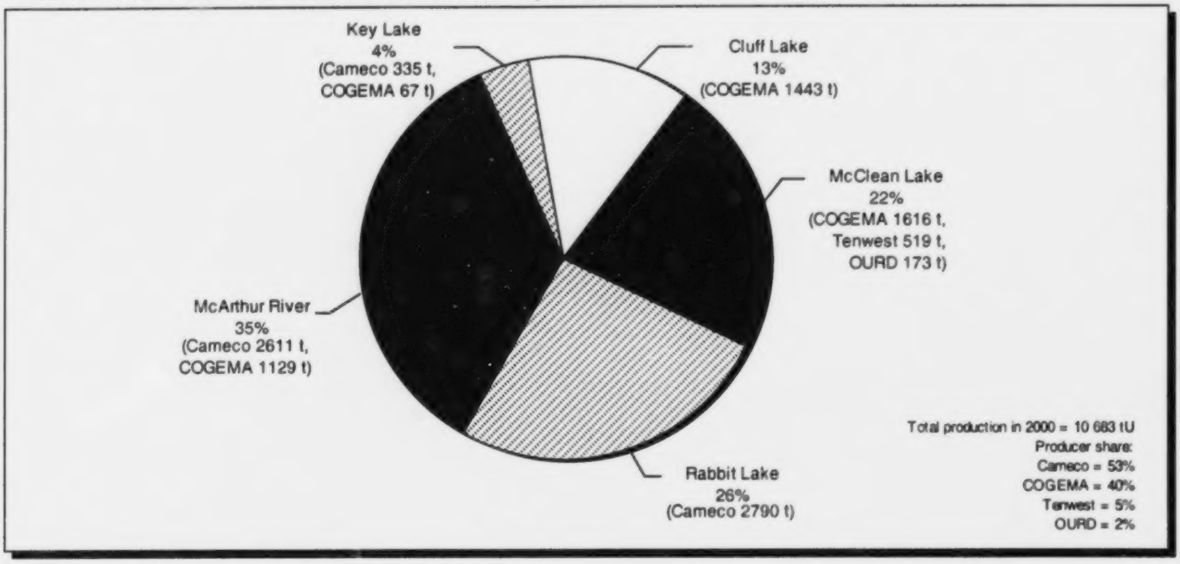
6. Midwest
7. Cigar Lake
8. Kiggavik

PAST PRODUCING OPERATIONS

9. Port Radium
10. Agnew Lake
11. Madawaska et al (Bancroft)
12. Rayrock (Marian River)
13. Beaverlodge et al
14. Quirke/Panel/Denison and Stanleigh et al (Elliot Lake)
15. Gunnar and Lorado et al

Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

Figure 3
Canadian Uranium Production and Ownership, 2000



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.
Cameco: Cameco Corporation; COGEMA: COGEMA Resources Inc.; OURD: OURD (Canada) Co. Ltd.; Tenwest: Tenwest Uranium Ltd.
Notes: Production reflects equity interest in production facilities. Tenwest is a wholly owned subsidiary of Denison Mines Limited.

Commission (CNSC). Although uranium mining and milling ceased at these facilities over 30 years ago, Rio Algom is currently in the process of obtaining a CNSC radioactive waste facility operating licence, which is expected in 2002.

Athabasca Basin, Saskatchewan

McArthur River

The McArthur River mine, the world's largest high-grade uranium deposit discovered to date, is a Cameco-CRI joint venture operated by Cameco. Mining began at McArthur River in December 1999 and commercial design capacity of 577 tU per month was achieved throughout most of 2001. Production in 2001 totalled 6639 tU, up sharply from 2000 production of 3740 tU.

Mining high-grade uranium requires the use of innovative high-tech, remote-controlled, non-entry methods. The high water content of the McArthur River ore and surrounding rock requires the use of a calcium chloride brine to create a freeze curtain separating the water-bearing sandstone from the ore. The use of remote-controlled methods, including raise boring, underground crushing and grinding circuits, and transporting the ore to the mill in purpose-designed containers that are loaded and unloaded at specially designed, remote-controlled stations, minimizes workers' exposure to radiation.

McArthur River reserves currently total over 175 000 tU (at an average grade of over 17% U), sufficient for over 20 years of operation at current production rates.

On October 30, 2001, the CNSC renewed the McArthur River uranium mine operating licence for a term ending on February 28, 2004. A conceptual decommissioning and reclamation plan and an $8.6 million letter of credit to implement this plan have been filed with the Government of Saskatchewan.

Key Lake

The Key Lake project is a Cameco and CRI joint venture operated by Cameco. Local deposits were mined out in 1997, but the mill continues operating, processing McArthur River ore. In 2001, Key Lake produced 6938 tU, up sharply from the 2000 total of 4142 tU. All but 299 t of 2001 uranium production was derived from McArthur River ore. The small contribution from Key Lake came from stockpiled low-grade ore which is used to *lower* the McArthur River ore grade to about 3.5% U before being run through the mill circuit.

A 1998 agreement with International Uranium Corporation of Denver, Colorado, has facilitated the processing of uranium-bearing by-products from Cameco's Blind River refinery and Port Hope conversion plant at the White Mesa Mill in Utah. In 2001, Cameco completed a pilot test program to recycle these by-products at the Key Lake mill in order to develop information required to support an application to recycle these by-products at that mill on a regular basis.

On October 30, 2001, the CNSC renewed the Key Lake uranium mine operating licence for a term ending on February 28, 2004. A conceptual decommissioning and reclamation plan has been filed with the Government of Saskatchewan, along with a $45.6 million letter of credit.

McClean Lake

The McClean Lake uranium production facility is majority-owned and operated by CRI. In 2001, production amounted to 2540 tU, up from the 2308 tU produced in 2000. On August 31, 2001, the CNSC renewed the McLean Lake uranium mine operating licence for a term ending on August 31, 2005, with an increased annual production limit of 3077 tU.

During 2001, the McClean Lake mill was fed by low- to high-grade ore from the Sue C open pit and low-grade stockpiled ore from the JEB open pit. Mining of the Sue C deposit was completed in February 2001. After follow-up activities were completed, such as ore haulage and select reclamation activities, about 40 of the McLean Lake mining staff were laid off at the end of May 2001.

The Sue C deposit produced almost 550 000 t of ore with an average grade of about 2% U, containing over 10 000 tU. Combined with the remaining ore from the mined-out JEB deposit, the McLean Lake ore stockpile is sufficient to provide feed for the mill for several years.

A conceptual decommissioning and reclamation plan and a financial guarantee of $35 million, assured by letters of credit, has been filed with the Government of Saskatchewan.

Rabbit Lake

The Rabbit Lake uranium production facility is wholly owned and operated by Cameco. Mill output in 2001 amounted to 1755 tU, down significantly from 2000 production of 2790 tU, owing to Cameco's decision to suspend operations at the mill after stockpiled ore was depleted in May 2001. Mining had been suspended in March 1999. Cameco has re-evaluated the mining plan for the Eagle Point underground mine and is expected to resume mining in mid-2002 with milling expected to resume later that same year.

The remaining Eagle Point reserves total over 6500 tU with an average grade of about 1% U, sufficient to provide feed for the mill until about 2005. Subject to regulatory approval and mutually satisfactory business arrangements among the owners of the Cigar Lake mine, deliveries of Cigar Lake ore to Rabbit Lake could commence as early as 2007. An Environmental Impact Statement outlining plans to mill about half of the Cigar Lake ore at Rabbit Lake is expected to be filed with regulatory agencies in 2003.

In July 2001, International Atomic Energy Agency (IAEA) personnel inspected surface and underground facilities at Rabbit Lake. This was the first inspection of its kind in Canada under the IAEA's strengthened safeguard system that now extends to the front end of the nuclear fuel cycle. The objective of this short-notice complementary access inspection was to ensure consistency with Canada's declared nuclear fuel cycle activities. Complementary access was provided as outlined in procedures now incorporated in CNSC uranium mine operating licences.

On October 30, 2001, the CNSC renewed the Rabbit Lake uranium mine operating licence for a term ending on October 31, 2003. A conceptual decommissioning and reclamation plan has been filed with the Government of Saskatchewan, along with a $36 million letter of credit to cover the costs of implementing this plan.

Cluff Lake

The Cluff Lake uranium production facility is wholly owned and operated by CRI. The mill operated throughout most of 2001 on an alternate week schedule. Overall production amounted to 1288 tU, down slightly from the 1443 tU produced in 2000. Mining of the west Dominique-Janine deposit was completed on May 31, 2002. The current plan is to continue operating the mill until December 2002 in order to process all stockpiled ore and then suspend operations at the site.

CRI continues site clean-up and reclamation activities in anticipation of the suspension of operations. Buildings and structures no longer required have been dismantled. In 2001, the placement of a 1-metre soil cap on the tailings management upper solids area began and portions of the Claude waste rock pile were levelled and re-sloped. A test till cover and groundwater wells with instrumentation were installed to gather information on the potential environmental impacts of the waste rock pile.

On December 28, 2001, the CNSC renewed the Cluff Lake uranium mine operating licence with a term extending to the end of April 2004, which permits the completion of the planned mining and milling activities. A conceptual decommissioning and reclamation plan has been filed with the Government of Saskatchewan, along with a $33.6 million letter of credit to cover the costs of implementing this plan.

Cigar Lake

The Cigar Lake mine is a joint venture that has been developed by the Cigar Lake Mining Corporation. Effective January 1, 2002, Cameco became the operator of the project. This change had no effect on the ownership of the mine (Table 4).

Cigar Lake is the world's second largest high-grade uranium deposit discovered to date with reserves totalling over 85 000 tU at an average grade of over 17%. After an updated feasibility study incorporating the results of additional jet-boring mining tests was approved by the joint-venture owners in June 2001, a detailed engineering design was initiated. Subject to market conditions and regulatory approvals, the mine could enter into production as early as 2005.

Subject to regulatory approvals, the mining method will consist of 4-m-diameter holes bored with a high-pressure water jet. As at McArthur River, the high water content of the ore and surrounding rock means that the deposit must be frozen prior to mining. The ore will be ground and mixed into a slurry underground, pumped to the surface, loaded into specialized containers and trucked to McClean Lake for processing. For the first phase of mining, about one-half of the ore will be processed entirely at McLean Lake with the remainder expected to be shipped to Rabbit Lake for further processing after it has reached the pregnant aqueous solution stage at McLean Lake.

On December 11, 2001, the CNSC issued a uranium mine-site preparation licence with a term extending to July 31, 2004. The main activity over the duration of this licence will be operating the site on a care and maintenance basis. A conceptual decommissioning and reclamation plan for test mining infrastructure and surface disturbance has been filed with the Government of Saskatchewan, along with financial assurance amounting to $4.2 million.

Additional Production Possibilities

Beyond the existing and committed centres of uranium production mentioned above, there are two projects that could be brought on stream in the next few years, subject to favourable market conditions and the receipt of environmental and regulatory approvals. Table 4 updates, as of June 1, 2002, recent developments at the mining projects that could contribute to Canada's uranium production capability in the future.

Environmental Assessments

CRI's decommissioning plan for the Cluff Lake project is the subject of a comprehensive environmental assessment study pursuant to the *Canadian Environmental Assessment Act*. Once all questions from regulatory agencies have been satisfactorily addressed by CRI (anticipated in July 2002), the document will be submitted to the Canadian Environmental Assessment Agency for public review. Once completed, the licensing process with federal and provincial agencies can be initiated.

In 2001, CRI and the Cigar Lake Mining Corporation submitted a screening environmental assessment that outlines options for disposing of potentially acid-generating waste rock from the Cigar Lake mine. After reviewing several options, it was determined that disposal in the mined-out Sue C pit at McClean Lake is the environmentally preferred option as it is expected to produce no significant environmental effects. Public consultations are continuing and the report is being reviewed by regulatory agencies.

A comprehensive environmental assessment study of the proposal to mill approximately half of the Cigar Lake ore at the Rabbit Lake mill is expected to be submitted to regulatory agencies in 2003. Subject to regulatory approvals and mutually agreeable business arrangements among the joint-venture partners, ore from Cigar Lake could provide feed for the Rabbit Lake mill for some 15 years.

Other Developments Affecting Canada's Uranium Industry

In October 2000, Cameco announced that it had signed an agreement with British Energy plc to acquire a 15% interest in the Bruce Power Partnership (Bruce Power). Under the terms of the agreement, which came into effect on May 12, 2001, Cameco assumed full responsibility for managing all of Bruce Power's fuel procurement needs.

The Bruce nuclear power station consists of four Bruce B reactors currently operating and four laid-up Bruce A reactors. In April 2001, Bruce Power announced that it planned to restart two of the laid-up Bruce A reactors (Units 3 and 4; an additional 1500 MWe). The two Bruce A reactors are expected to be back in operation in 2003, subject to regulatory approvals. The total cost of the restart is estimated to be in the order of $340 million.

On February 12, 2001, Cameco received a gold level achievement award from the Canadian Council for Aboriginal Business. The award recognizes Cameco's commitment to establishing a fair and balanced business relationship with Aboriginal communities in northern Saskatchewan.

EXPLORATION

Natural Resources Canada (NRCan) completed its 26th annual assessment of Canada's uranium supply capabilities and reported[2] the results in October

2001. Uranium exploration activity remains concentrated in areas favourable for the occurrence of deposits associated with Proterozoic unconformities, notably in the Athabasca Basin of Saskatchewan and the Thelon Basin of the Northwest Territories and Nunavut. In 2000, overall uranium exploration expenditures reached $46 million while uranium exploration and surface development drilling amounted to over 77 000 m, down from the 89 000 m reported for 1999.

As in recent years, most of the overall exploration expenditures can be attributed to advanced underground exploration, deposit-appraisal activities and care-and-maintenance expenditures associated with those Saskatchewan projects awaiting production approvals. In comparison, the Saskatchewan government estimates that grass-roots uranium exploration in the province amounted to $18 million in 2000, up slightly from the 1999 total of $14 million. Table 5 summarizes uranium exploration activity in Canada from 1987 to 2000.

In recent years, the number of companies with major exploration programs in Canada has declined. The top five operators,[3] accounting for a major portion of the $46 million expended in 2000, were: Cameco Corporation, Cigar Lake Mining Corporation, CRI, JNR Resources Ltd., and Pioneer Metals Corporation. Expenditures by CRI include those of Urangesellschaft Canada Limited.

On October 21, 2001, Cameco and Pioneer Metals Corporation announced that they had entered into an agreement to form a new public company, UEX Corporation, to focus on uranium exploration in the Athabasca Basin. A condition required to close this arrangement is that third-party financing be obtained. After closing, Cameco will retain a 40% interest in UEX.

RESOURCES

NRCan's annual assessment of domestic uranium supply capability provides a compilation of Canada's "known" uranium resources, based on the results of an evaluation of company data. Uranium supply from Canada in the next decade will come from known resources, estimates of which are divided into three major categories, *measured*, *indicated* and *inferred*, which reflect different levels of confidence in the reported quantities. Most of these resources are associated with deposits identified in Figure 2.

Recent NRCan assessments of Canada's uranium resources have been restricted to those recoverable from mineable ore at prices of $100/kgU or less. Table 6 shows the breakdown of the latest resource estimates, compared with those of the previous year. As of January 1, 2001, total recoverable known uranium resources were estimated at 437 000 tU, compared with 417 000 tU as of January 1, 2000. This upward adjustment of about 5% primarily reflects increased McArthur River resources.

SUPPLY CAPABILITY

In 2001, Canada's uranium supply capability increased as McArthur River production was successfully ramped up to design capacity and licensed production capacity was increased at McClean Lake. A continued smooth transition to other new mines, combined with timely licensing approvals and improved market conditions, will be required to allow Canada's production capability to expand to its full potential of some 15 000 tU annually.

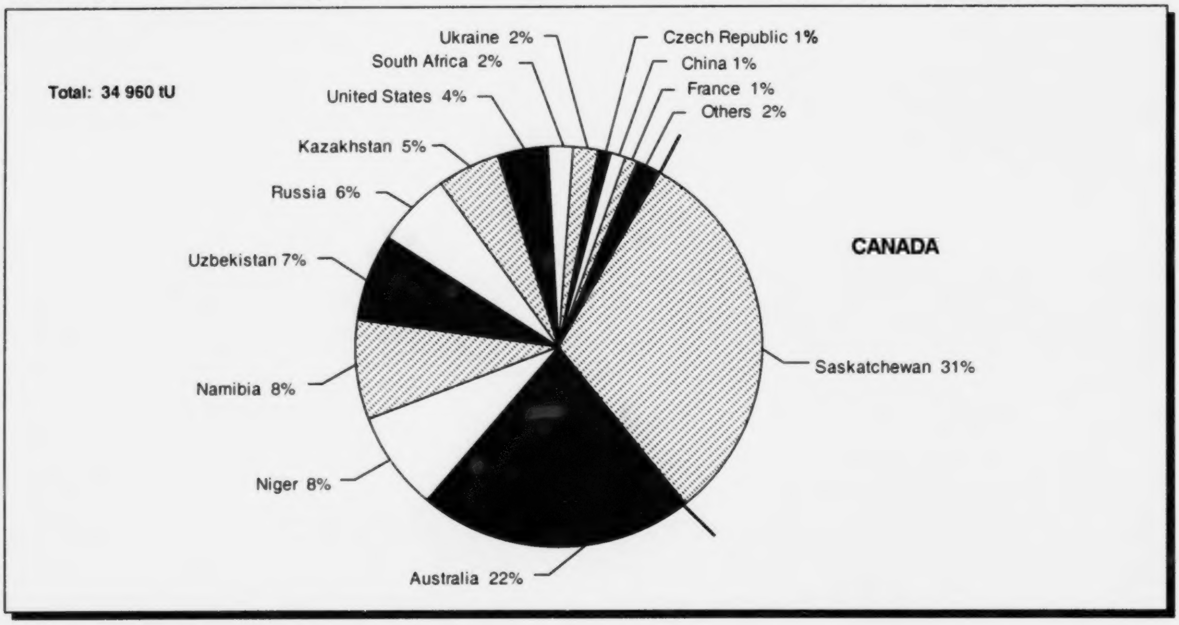
Developments in the international uranium market, the rate at which projects receive environmental approvals, and uncertainty regarding the costs associated with certain of the planned new projects preclude projecting future production capability levels with much certainty. Table 7 ranks Canada among the world's major producers, showing actual uranium production from 1996 through 2000. Figure 4 illustrates Canada's share of world output in 2000 compared with other major producers.

GOVERNMENT INITIATIVES

On January 1, 2001, the Government of Saskatchewan implemented a revised royalty system that consists of both a basic and tiered royalty. The basic royalty is equal to 5% of the gross uranium sales, reduced by a Saskatchewan Resource Credit equivalent to 1% of the gross sales. An additional tiered royalty, which increases with the price of uranium, is applied after capital allowances for mine and mill development are reduced to zero.

On June 13, 2002, *An Act Respecting the Long-Term Management of Nuclear Fuel Waste* received Royal Assent. The legislation requires nuclear utilities to form a waste management organization that will report regularly to the Government of Canada and provide recommendations on the long-term management of nuclear fuel waste. The legislation also requires that the utilities establish a trust fund to finance implementation of the management approach, ensuring that Canadian taxpayers are not exposed to this financial liability over the long term.

Figure 4
World Uranium Production, 2000



Source: Uranium and Radioactive Waste Division, Natural Resources Canada.

THE URANIUM MARKET

Overview

During the course of 2001, there was a good deal of talk of a "nuclear renaissance," particularly in the United States, coupled with positive press coverage. In May, the United States released its National Energy Policy, which was very supportive of the role of nuclear power. Serious energy shortages in California during the spring drew worldwide attention. These events began to stimulate public debate on energy policy and a more favourable public attitude toward nuclear power emerged. It has become clear that it could be difficult to meet Kyoto Protocol targets without a significant contribution from nuclear electricity generation. This may bode well for uranium demand five or ten years from now.

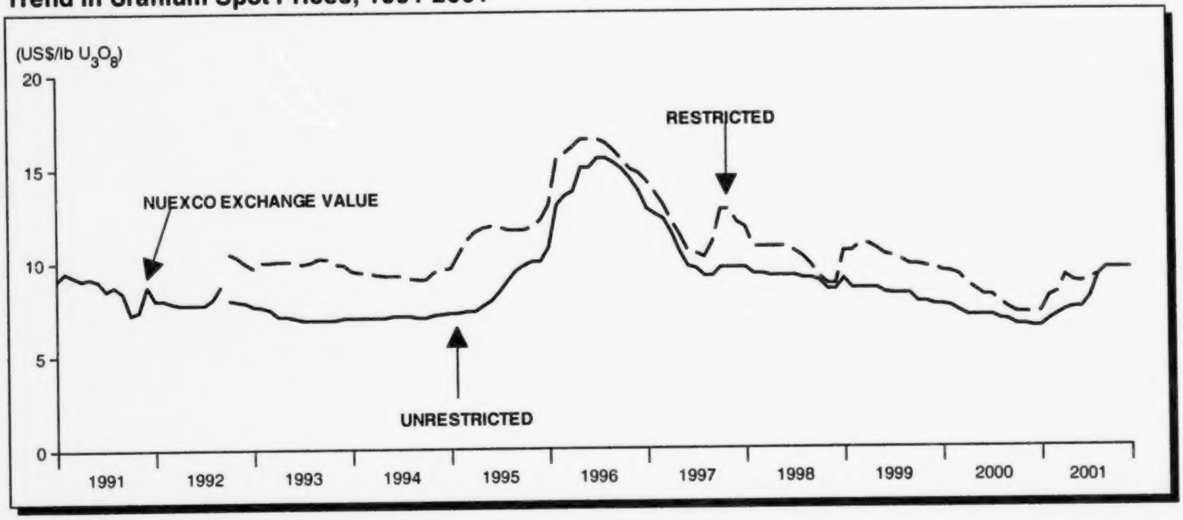
Against this background, spot market prices rose generally during the year, ending it 34% higher than they started. The Euratom Supply Agency relaxed its restrictions on the import of Kazakh- and Uzbek-origin uranium, leaving Russian uranium as the only origin still subject to restrictions in Western markets. During September, all of the major organizations reporting on spot prices ceased publication of a separate price attributable to uranium from the former Soviet Union and the market once again converged to a single uranium price.

During November, Cameco, COGEMA S.A., and RWE Nukem Inc. announced that they had agreed to purchase from the Russian company Techsnabexport Co. Ltd. firm quantities of uranium arising from the agreement on Highly Enriched Uranium (HEU) between the United States and the Russian Federation. These quantities, which had formerly been covered by options, were at least equal to the respective shares of these companies in the quota allowing for the sale of this uranium in the U.S. market over the remaining term of the HEU Agreement from 2002 through 2013. These commitments placed this important disarmament agreement on a stable commercial footing and provided the Russian government with a predictable long-term revenue stream.

Uranium Prices

After reaching a historic low in real terms at the end of 2000, uranium spot market prices recovered throughout 2001. Figure 5 shows that the "restricted" spot market price, as reported by TradeTech,[4] began the year at US$7.10/lb U_3O_8 (uranium oxide concentrate, commonly referred to as yellowcake) and ended up at $9.50. The "unrestricted" spot market price, attributable to uranium from the former Soviet Union, followed a similar trend through the end of August. Thereupon TradeTech, and other organizations reporting uranium spot prices, discontinued publication of this separate price following the

Figure 5
Trend in Uranium Spot Prices, 1991-2001



Source: *TradeTech.*

cessation of U.S. and European Union restrictions against all but Russian-origin uranium.

The average price of Canadian export deliveries declined from \$47.70/kgU (US\$12.40/lb U_3O_8) in 2000 to \$46.60/kgU (US\$11.60/lb U_3O_8) in 2001. Table 8 shows the export price trend from 1978 to 2001 while Table 9 indicates actual exports of Canadian-origin uranium to principal customers from 1995 to 2000. The destination of Canada's exports of uranium on a cumulative basis (1996-2000 inclusive) is illustrated in Figure 6, which highlights the importance of the United States as a customer.

REFINING AND CONVERSION

Cameco operates Canada's only uranium refining and conversion facilities, located at Blind River and Port Hope, Ontario, respectively. At the Blind River refinery – the world's largest – uranium mine concentrates from Canada and abroad are refined to uranium trioxide (UO_3), an intermediate product. The UO_3 is then trucked to the Port Hope facilities, which have about one-quarter of the Western World's annual uranium hexafluoride (UF_6) conversion capacity and currently provide the only commercial supply of fuel-grade natural uranium dioxide (UO_2). UF_6 is enriched outside Canada for use in foreign light-water reactors while natural UO_2 is used to fabricate fuel bundles for CANDU reactors in Canada and abroad. About 80% of the UO_3 from Blind River is converted to UF_6 while the remaining 20% is converted to UO_2. Table 10 tabulates Canada's production of refined and converted uranium, and notes the associated work force from 1997 to 2000 inclusive.

On February 9, 2001, British Nuclear Fuels Limited (BNFL) announced that it intended to halt UF_6 production in 2006 and that it was immediately ceasing the marketing of its UF_6 conversion services. All uncommitted BNFL UF_6 conversion services were sold to Cameco.

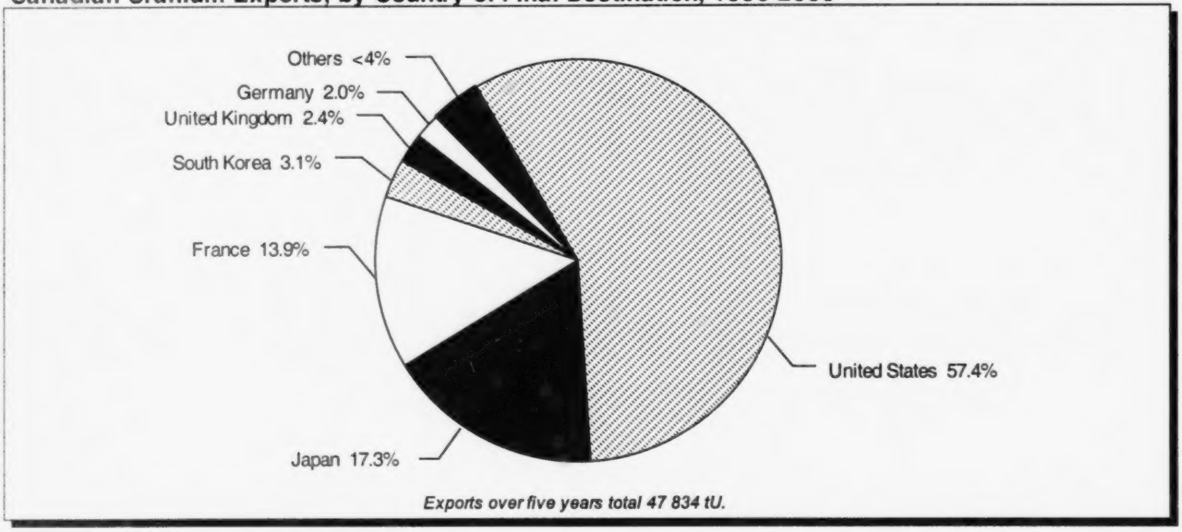
In March 2002, the Blind River refinery received certification under ISO 14001, the most widely recognized international standard for environmental management systems.

OUTLOOK

Talk of a "nuclear renaissance," particularly in the United States, coupled with positive press coverage, policy support for nuclear power in the United States, and a more favourable public attitude toward nuclear power, have improved the outlook for uranium producers. In addition, the realization that it could be difficult to meet Kyoto Protocol targets without a significant contribution from nuclear electricity generation may bode well for future uranium demand.

Improved market conditions will be welcomed by Canadian producers as they continue the transition to the new generation of uranium mines in northern Saskatchewan. With favourable market conditions and timely regulatory approvals, the Cigar Lake mine is expected to enter into production as early as

Figure 6
Canadian Uranium Exports, by Country of Final Destination, 1996-2000



Exports over five years total 47 834 tU.

Source: Canadian Nuclear Safety Commission.

2005. Continued success in bringing operations on stream will ensure that Canada remains the world's premier uranium producer well into the 21st century.

ENDNOTES

[1] John French, Advisor, Uranium Markets (tel. 613-995-7474), has contributed to the text in those sections dealing with international uranium market developments and uranium prices.

[2] *Canada's Uranium Industry 2001 - Production Rebounds with New Mines On Stream* - NRCan Mailing, October 2001.

[3] In certain cases, the identified operator has reported the total expenditures of a joint-venture effort. Therefore, contributions by other parties not responding to the NRCan survey are accounted for in the $46 million total expenditure for 2000.

[4] NUEXCO, an international uranium brokerage firm, was originally called the Nuclear Exchange Corporation. Several companies in the NUEXCO organization, which were associated with uranium trading, declared bankruptcy in early 1995. Certain of these have been reorganized and continue to provide brokerage services. NUEXCO's publication activities are carried on by TradeTech.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to chapter 64. (2) Information in this review was current as of June 15, 2002. (3) This paper on uranium and other information on developments in Canadian nuclear policy can be accessed on the Internet at nuclear.nrcan.gc.ca. (4) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

TABLE 1. URANIUM PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1998-2000

Production Centre and Producer	Company Work Force (1) (Dec. 31)			Annual Output (2) (tU)		
	1998	1999	2000	1998	1999	2000
ATHABASCA BASIN, SASKATCHEWAN						
Cluff Mining (COGEMA Resources Inc., 100%)	158	151	105	1 039	1 234	1 443
Key Lake JV (Cameco operator)	285	277	260	5 392	3 715	402
Rabbit Lake JV (Cameco, 100%)	287	155	156	4 491	2 705	2 790
McClean Lake JV (COGEMA Resources Inc. operator)	265	283	258	–	560	2 308
McArthur River JV (Cameco operator)	89	157	225	–	–	3 740
Cigar Lake JV (pre-production)	50	53	22	–	–	–
Total	1 105	1 134	1 026	10 922	8 214	10 683

Sources: Company annual reports; Canadian Nuclear Safety Commission open files.
– Nil.
(1) Figures are for company payroll employees only; on-site contractors (mining, construction, services, etc.) are not included. (2) Primary output only.

TABLE 2. VALUE(1) OF URANIUM SHIPMENTS(2) BY PRODUCERS IN CANADA, 1997-2001

	Unit	1997	1998	1999	2000	2001 (p)
Total producer shipments	tU	11 127	9 984	10 157	9 921	12 922
Total value of shipments	$ millions	554	500	500	485	600

Source: Natural Resources Canada.
(p) Preliminary.
(1) Value of shipments is estimated from an average market price. (2) Shipments in tonnes of uranium (tU), contained in concentrate, from ore-processing plants.

TABLE 3. OPERATIONAL CHARACTERISTICS OF EXISTING CANADIAN URANIUM PRODUCTION CENTRES, 2000

Operating Entity (Operator)/Location	Ore-Processing Plant (1)			
	Capacity	Recovery	Annual Throughput	
	Nameplate	Overall	Total Ore	Ore Grade
	(t/d)	(%)	(t)	(%)
Cluff Mining (COGEMA Resources Inc.)/ Cluff Lake, Saskatchewan	800	98	117 005	1.27
McClean Lake JV (COGEMA Resources Inc.)/ McClean Lake, Saskatchewan	300	97	81 966	2.90
Rabbit Lake (Cameco Corporation)/ Rabbit Lake, Saskatchewan	1 920	97	216 170	1.33
Key Lake JV (Cameco Corporation)/ Key Lake, Saskatchewan (2)	750	97	186 514	2.37

Sources: Corporate annual reports; Canadian Nuclear Safety Commission open files.
(1) Figures are rounded. (2) All McArthur River ore is processed at Key Lake.

TABLE 4. CANADIAN URANIUM MINING PROJECTS PLANNED FOR PRODUCTION AS OF JUNE 1, 2002

Project, Province or Territory/Operator	Owners Share	Deposit Type/ Discoverer and Discovery Date	Resources (Company Estimates as of May 29, 2002)	Ore Grade and Notes on Deposits	Mining Method, Milling Rate and Capacity	Project Particulars and Status	Location of Project/ Notes of Interest
	(%)						
Cigar Lake, Sask./ Cameco Corporation	Cameco (50.025), COGEMA Resources Inc. (37.100), Idemitsu (7.875), TEPCO (5)	Unconformity-related/ COGEMA Resources Inc., 1981	Overall property 135 000 tU *mineable*	Overall property grade of 14% U; grades vary from 5% to 70% U; orebody at depth of 450 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake and Rabbit Lake; contributing from 2300 to 6900 tU/y	$555 million project; test mining completed in 1992; EIS submitted in October 1995; Joint Panel reports November 1997; government response April 1998; comprehensive study of Rabbit Lake milling option to begin in 2002	670 km N of Saskatoon; 500-m-deep shaft sunk; brine freezing of ground is required to mine the ore; production to begin as early as 2005
Midwest, Sask./ COGEMA Resources Inc.	COGEMA Resources Inc. (54.8), Redstone Resources Inc. (20.7), Tenwest Uranium Ltd. (20), OURD (4.5)	Unconformity-related/ Esso Minerals Canada, 1977 (interests of Bow Valley, Numac Oil & Gas, *et al* bought by partners)	Overall property 13 800 tU *mineable*	Overall property grade of 4.5% U; grades vary from 2% to 30% U; orebody at depth of 200 m	"Non-entry" underground; "jet-boring" mining method; milling at McClean Lake; contributing 2300 tU/y	$80 million co-venture with McClean; in 1993, Joint Panel rejects proposal; new EIS in 1995; final hearings August 1997; Joint Panel report November 1997; government response April 1998	710 km N of Saskatoon; 185-m-deep test-mine shaft; new operator, COGEMA Resources Inc. revised EIS; start-up subject to feasibility study
Kiggavik, Nunavut/ Urangesellschaft Canada Limited	Urangesellschaft (79), COGEMA Resources Inc. (20), Daewoo Corporation (1)	Unconformity-related/ Urangesellschaft, 1977	Overall property 15 000 tU *mineable* ; (more incl. Andrew Lake *et al*)	0.41% U average overall; Centre pit depth 100 m, Main pit 200 m	Open-pit mining methods; mill feed at 1200 t/d; output rate of 1200 tU/y originally expected	EIS submitted but project deemed deficient by Panel; new EIS required before project start-up	75 km W of Baker Lake; start-up not expected in the near future; >11-year mine life with tributary ore included

Notes: OURD (Canada) Co., Ltd. is a subsidiary of the Overseas Uranium Resources Development Corporation (OURD) of Japan. Urangesellschaft Canada Limited, operated by COGEMA Resources Inc., is a subsidiary of COGEMA S.A., which is wholly owned by the AREVA Group of France. Idemitsu Uranium Exploration Canada Ltd. is a wholly owned subsidiary of Idemitsu Kosan Co., Ltd. of Japan. TEPCO Resources Inc. is a subsidiary of Tokyo Electric Power Co., Inc. (TEPCO), Japan's largest nuclear power utility. Redstone Resources Inc. is a subsidiary of Franco-Nevada Mining Corporation Limited. Tenwest Uranium Ltd. is a wholly owned subsidiary of Denison Energy Inc.

TABLE 5. URANIUM EXPLORATION ACTIVITY IN CANADA, 1987-2000

Year	Expenditures (1)	Drilling (2)	Million-Dollar Projects (3)
	($ millions)	(km)	(no.)
1987	37	164	12
1988	59	201	11
1989	58	158	11
1990	45	66	6
1991	44	67	4
1992	46	79	4
1993	40	62	5
1994	36	67	8
1995	44	75	10
1996	39	79	8
1997	58	104	6
1998	60	95	6
1999	49	89	3
2000	46	77	3

Source: Natural Resources Canada.
(1) Direct exploration and drilling expenditures in current dollars; from the late 1980s, includes advanced underground exploration and deposit appraisal expenditures; from the mid-1990s, may also include care-and-maintenance costs associated with deposits awaiting production approvals. (2) Exploration and surface development drilling; excludes development drilling on producing properties. (3) Number of projects where direct exploration and drilling expenditures exceeded $1 million in current dollars.

TABLE 6. ESTIMATES OF CANADA'S URANIUM RESOURCES RECOVERABLE FROM MINEABLE ORE,(1) JANUARY 1, 2000, AND JANUARY 1, 2001

Price Ranges Within Which Mineable Ore is Assessed (2)	Measured		Indicated		Inferred	
	1/1/00	1/1/01	1/1/00	1/1/01	1/1/00	1/1/01
			(000 tU)			
Up to C$50/kgU	201	258	29	20	128	103
C$50 to $100/kgU	–	–	39	36	20	20
Total	201	258	68	56	148	123

Source: Natural Resources Canada.
– Nil.
(1) Actual or expected losses in mining recovery and ore processing have been accounted for; these factors were individually applied to resources tributary to existing or prospective production centres. In underground operations, mineable ore is generally 75-85% of the ore-in-place; higher mining recoveries are achievable in open-pit operations. Canada's weighted average ore processing recovery for existing conventional operations exceeded 97% over the 2000/2001 period. (2) The Canadian dollar figures reflect the price of a quantity of uranium concentrate containing 1 kg of elemental uranium. The prices were used in determining the cut-off grade at each deposit assessed, taking into account the mining method used and the processing losses expected. The price of $100/kgU was used by Natural Resources Canada to illustrate those resources that were of economic interest to Canada during the survey period.
Note: $1/lb U_3O_8 = $2.6/kgU.

TABLE 7. PRODUCTION OF URANIUM IN CONCENTRATES BY SELECTED MAJOR PRODUCING COUNTRIES, 1996-2000

	1996	1997	1998	1999	2000
			(tonnes U)		
Canada (1)	11 750	12 030	10 920	8 210	10 680
Australia	4 970	5 520	4 910	5 980	7 580
China	560	500	500	500	500
France	930	750	510	440	310
Gabon	570	470	730	290	–
Kazakhstan	1 210	1 000	1 270	1 350	1 740
Namibia	2 450	2 900	2 760	2 690	2 710
Niger	3 320	3 500	3 730	2 920	2 900
Russia	2 600	2 000	2 000	2 000	2 000
South Africa	1 440	1 100	990	980	870
Uzbekistan	1 460	1 760	1 930	2 130	2 350
United States	2 430	2 170	1 810	1 810	1 460
Other (2)	2 540	1 990	1 730	1 770	1 860
Total (3)	36 230	35 690	33 790	31 070	34 960

Sources: *Uranium: Resources, Production and Demand*, a biennial report published jointly by the Nuclear Energy Agency of the OECD and the International Atomic Energy Agency, and miscellaneous corporate, national and international reports.

– Nil.

(1) Includes refinery/conversion facility by-product prior to 1997; differs from primary production figures shown elsewhere. (2) Includes Argentina, Belgium, Brazil, Bulgaria, the Czech Republic, Germany, Hungary, India, Israel, Japan, Mongolia, Pakistan, Portugal, Romania, Spain, Ukraine and Yugoslavia. (3) Totals are of the listed figures only and represent global production.

Note: Country figures are rounded to the nearest 10 tU.

TABLE 8. CANADIAN URANIUM EXPORT PRICE,(1) 1978-2001

	Average Export Price		Spot Sale
Year	Current Dollars	Constant 2000 Dollars	Portion of Deliveries
		($/kgU) (2)	(%)
1978	125	293	n.r.
1979	130	278	n.r.
1980	135	260	n.r.
1981	110	193	1
1982	113	183	1.5
1983	96	150	10
1984	90	134	26
1985	91	131	20
1986	89	124	21
1987	79	105	35
1988	79	101	13
1989	74	90	<1
1990	71	84	<1
1991	61	70	<2
1992	59	67	<1
1993	50	56	<1
1994	51	56	<1
1995	47	51	2
1996	53.60	57.07	1
1997	51.30	53.97	<1
1998	51.10	53.97	<2
1999	49.10	50.99	<1
2000	47.70	48.20	<1
2001	46.60	46.60	<2

Source: Natural Resources Canada.

n.r. Not reported.

(1) Derived annually based on the average price for all deliveries made by Canadian producers to export customers in the given year. (2) $/kgU x 0.38465 = $/lb U_3O_8.

Notes: Pre-1996 prices are rounded to the nearest dollar. Constant dollar values are derived using the Implicit Price Index for Gross Domestic Product.

TABLE 9. EXPORTS OF URANIUM OF CANADIAN ORIGIN, 1995-2000

Country of Final Destination	1995	1996	1997	1998	1999	2000
	(tonnes of contained uranium(1))					
Argentina	–	–	–	–	–	1
Belgium	3	115	–	–	–	110
Czech Republic	–	–	–	–	–	246
France	1 016	679	587	67	1 819	3 505
Germany	348	776	184	–	–	–
Japan	383	1 490	1 968	1 310	1 116	2 386
South Korea	290	261	315	444	309	172
Spain	166	103	160	–	121	97
Sweden	84	142	450	147	–	–
Taiwan	–	–	–	–	107	26
United Kingdom	188	250	374	345	–	193
United States	5 702	7 407	6 187	5 962	3 674	4 230
Total	8 180	11 223	10 225	8 274	7 146	10 966

Source: Canadian Nuclear Safety Commission.
– Nil.
(1) Some of this uranium was first exported to an intermediate country for conversion and/or enrichment prior to transfer to the country of final destination.

TABLE 10. URANIUM PROCESSING PRODUCTION AND ASSOCIATED WORK FORCE IN CANADA, 1997-2000

Process and Location (Nameplate Capacity)	Production				Site Work Force			
	1997	1998	1999	2000	1997	1998	1999	2000
	(tU)				(number)			
Refining at Blind River (18 000 tU as UO_3)	12 195	12 031	11 360	9 605	102	96	98	98
Conversion at Port Hope (12 500 tU as UF_6 and 2800 tU as UO_2)	12 594	11 169	11 231	9 327	277	271	272	267

Source: Cameco Corporation.

Vanadium

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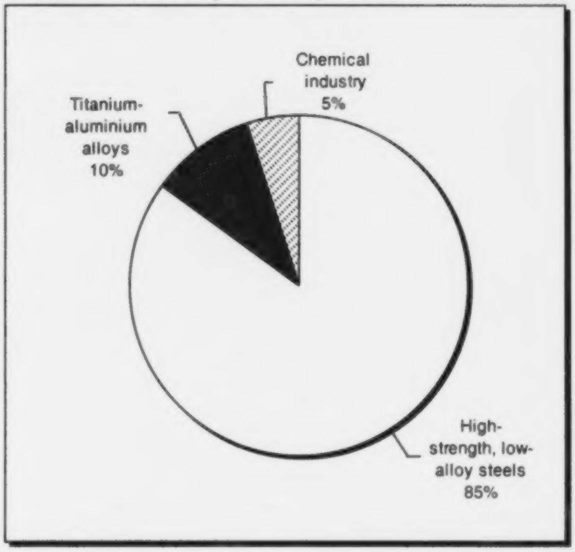
Vanadium, element no. 23 of Mendeleyev's periodic table, is listed as the 22nd most abundant element on earth and is found in a large number of minerals, of which the most important are carnotite, roscoelite, vanadinite, mottramite and patronite. However, because vanadium is usually recovered as a by-product or co-product, it is generally sourced in its primary state from deposits of titaniferrous magnetite, phosphate and uranium, as well as from crude oils where it is found as a minor element. Vanadium can also be sourced by recycling spent catalysts from the petrochemical industry and ash produced by the combustion of oil emulsion in power stations. However, recycling activities are believed to account for only a few percent of total world supply.

Vanadium's main industrial use, 85% of consumption, is in the production of high-strength, low-alloy steels (HSLA) and tool and die steels. Another 10% is used in the manufacture of titanium-aluminum alloys for the aerospace industry while about 5% is used in the chemical industry (Figure 1).

Figure 1
Vanadium, Use by Industry Sector



Source: United States Geological Survey.

Vanadium is used in the steel industry for its property as an active grain refiner and as a strong deoxidant, and can impart strength, hardness and wear resistance to steels. Additions to steel are made primarily in the form of ferrovanadium, which is produced mostly by using the aluminothermic process or an electric furnace. With the aluminothermic process, a mixture of vanadium pentoxide, aluminum, ferrous scrap and a flux is charged to a refractory-lined open steel crucible. The reaction is initiated by using a fuse of barium pentoxide mixed with aluminum or magnesium powder to ignite the charge. If an electric furnace is used, less aluminum is needed and less vanadium is lost to the slag, but the process is more energy-intensive.

In the steel industry, HSLA steels have gradually replaced carbon steels in many instances where the higher intrinsic strength of HSLA steel permits a lower design weight that can offset the somewhat higher per-unit weight cost to better compete against aluminum products. The lighter weight results in savings in energy consumption costs in the transportation industry while the addition of vanadium improves the weldability of the steels. The major uses of HSLA steels are in pipelines, concrete reinforcing bars, structural shapes, tool steels, and automobile components. In these applications, niobium and vanadium are largely interchangeable. The superalloy industry uses vanadium mainly for aircraft applications, such as for turbine blades and jet engines where high-temperature strength is essential.

In the nonferrous sector, vanadium's main use is as a stabilizer in titanium-aluminum alloys used in the aerospace industry. In this application there is essentially no substitute for vanadium as a strengthening element. In the chemical industry, vanadium compounds are used in oxidation catalysts for the production of sulphuric acids and the cracking of petroleum products. It is also used as a glass and ceramic pigment, in permanent magnets, in dryers in paints and varnishes, in the processing of colour films, as a strengthening element in aluminum alloys, in small rechargeable batteries, and in catalysts for the control of exhaust fumes in diesel engines.

Current research on the use of vanadium in electrochemical energy storage systems may also open a new niche market and create significant growth prospects for the industry over the short to medium term. Vanadium Redox Flow Batteries (VRFB) use the chemical characteristics of vanadium to store electrical energy as chemical energy. Connected to an electrical grid, VRFB can be charged and discharged at will, making them an excellent back-up energy supply during power outages. VRFB can also be used to store electricity overnight for use during peak periods to take advantage of lower electricity rates or it can be used in electrical load levelling in power-generating units to prevent current fluctuations, which create problems for high-tech devices. So far, large-scale grid-connected units have been in demonstration in Japan, Australia, the Republic of South Africa (RSA) and the United States of America over the past few years and could be commercialized soon.

CANADIAN DEVELOPMENTS

Vanadium occurrences are widespread throughout Canada. However, the most common type of occurrence is vanadium contained in titaniferous magnetite. The grade of the best deposits, at 0.6% V_2O_5, is comparable to the grades of some deposits now being worked in other countries, but it is only slightly more than one third the grade of deposits being mined in the RSA. Vanadium was last produced in Canada in 1990/91 by Carbovan Inc., who recovered the material at the Fort McMurray oil refinery of Suncor Inc. in Saskatchewan during the processing of bituminous sands containing an average of 360 ppm of V_2O_5. The vanadium initially produced consisted of redcake, HVO_3, an intermediate higher-grade product, while the production of vanadium pentoxide was expected to start later on. The plant closed as a result of declining prices and difficulties in marketing this product. Canadian converter Masterloy Products Ltd., a wholly owned subsidiary of Walter Industries Inc. of the United States, produces both ferrovanadium and ferromolybdenum using the aluminothermic process. Canada imports all of its vanadium pentoxide requirements, which in 2001 were sourced mostly from Australia and the RSA. The Canadian ferrovanadium market for its part was supplied by both domestic and imported product from the RSA, China, Austria and the United States. Canada's principal users of ferrovanadium are integrated steel mills, specialty steel companies and mini-mills.

Future potential sources of vanadium in Canada are the Lac Doré, Bell River and Pipestone Lake deposits. All three of these deposits are located in titaniferous-magnetite-rich zones in bedded complexes.

- The **Lac Doré vanadium deposit** located about 70 km southeast of Chibougamau, Quebec, is the most advanced project. The most recent reserve estimate done by owner MacKenzie Bay International Ltd. (MacKenzie Bay) outlined measured and indicated resources of 102 Mt grading 35% magnetite, 17.4% ilmenite and 0.5% V_2O_5. This can be translated into combined proven, indicated and inferred mineable vanadium pentoxide resources of about 2.25 billion kg. In April 2001, the company commissioned SNC Lavalin Inc. to do a feasibility study that was scheduled to be completed by the end of March 2002. SOQUEM INC., a division of SGF Minéral Inc., which is a subsidiary of Société générale de financement du Québec, has the right to acquire a 20% interest in the project upon acceptance of a positive bankable study. If it goes through, MacKenzie Bay plans to develop an open-pit mine and to build a processing plant consisting of primary crushing and stockpiling, ore reclaiming, milling and magnetic separation of concentrate, and roasting and refining of magnetic concentrate. These installations would be complemented by the development of a processing facility with a capacity to produce 63.5 million litres of battery-grade vanadium electrolyte for use in vanadium redox batteries. The initial investment capital cost of the project is estimated at $364 million with a commissioning date set for June 2005.

- The **Bell River vanadium deposit**, also located in northwestern Quebec, is hosted in a bedded complex situated near Matagami. It was discovered in 1997 by Noranda Inc. and is at an early stage of evaluation. Geological resources of up to 200 Mt grading 0.4% V_2O_5 have been estimated at this site.

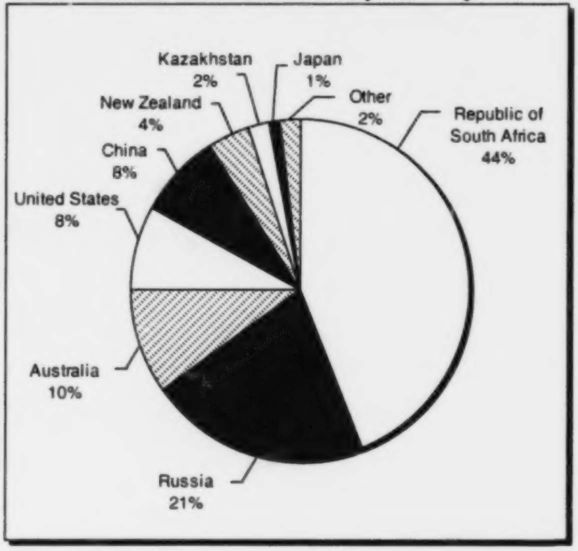
- The **Pipestone Lake deposit** was outlined in 1993 by joint-venture partners Gossan Resources Ltd. (51%) and Cross Lake Mineral Explorations Inc. (49%). Located about 600 km north of Winnipeg, Manitoba, the vanadium-bearing titaniferous-magnetite-rich zones are located in an anorthosite complex. Drill-indicated reserves stand at 40 Mt grading 8.72% TiO_2 and 0.4% V_2O_5, while geological resources are estimated at 685 Mt grading 8.37% TiO_2 and 0.2% V_2O_5.

WORLD OVERVIEW

World vanadium production statistics are not officially compiled, which in some ways is one of the root causes of the instability of the industry. However, according to published material, there are two schools of thought. The U.S. Geological Survey estimates total production of vanadium (from all sources) in recent years at about 43 000 t of vanadium content, while the RSA Department of Minerals and Energy estimates this production at about 33 000 t of vanadium content, the difference between the two figures resulting mostly from the double-counting of units. The production is deemed to have increased marginally compared to the previous year. In contrast, world use of vanadium in 2000 is estimated to have increased by as much as 7% along with increased steel production. The production of vanadium pentoxide in the world is restricted to a small number of countries. Based on annual vanadium pentoxide production capacity from all sources, one could venture that the world's production can be split as follows (Figure 2): RSA, 44%; Russia, 21%; Australia, 10%; the United States, 8%; China, 8%; New Zealand, 4%; Kazakhstan, 2%; Japan, 1%; and others, 2%.

- In the **Republic of South Africa**, vanadium occurs in seams of titaniferous magnetite located in the Bushveld Complex, one of the largest bedded mafic intrusives of the world. These seams grade an average of 1.5% V_2O_5 and can be traced on strike for up to 325 km. The RSA's estimated 12.5 Mt of contained vanadium (to a depth of 50 m) represents the world's largest reserves. The country's production of vanadium in 2001 is estimated at 19 000 t of vanadium content. This production comes from four companies: Anglo American's Highveld Steel and Vanadium Corporation Limited (Highveld), Vametco Minerals Corp. (Vametco), Vanadium Technologies (Vantech), and Rhombus Vanadium Holdings Ltd. (Rhovan).

Figure 2
World Vanadium Production by Country



Sources: United States Geological Survey; Department of Minerals & Energy, Republic of South Africa.

Highveld, the largest producer of vanadium in the Western World, significantly reduced production at its facilities in recent years in response to excess capacity in the marketplace. It operates the Mapochs mine in the northeastern province of Mpumalanga where it extracts vanadium-rich titaniferrous magnetite. It also produces vanadium-rich slag and oxides from two plants at its works in Witbank located 110 km from the mine. Slag is recovered from the Highveld steelworks and is processed with ore at the Vantra plant, which has an 8170-t/y (contained vanadium) roasting capacity to produce pentoxide. Most of this material is converted to ferrovanadium on site using both the aluminothermic and electric arc processes. Highveld also produces vanadium trioxide and other derivative vanadium chemicals at its Wapadskloof plant near Middleburg.

Vametco, a subsidiary of **Strategic Minerals Corp. (Stratcor)** of the United States, produces ferrovanadium and the proprietary nitrogen-containing Nitrovan alloys. Because of poor market prices, the company has, over the years, scaled down its vanadium mining operations and switched its feedstock to the use of vanadium-bearing slags from South African steel producers. Its production capacity was last upgraded in 1997 to about 6000 t/y of vanadium content in favour of an increase in Nitrovan alloy production.

Xstrata AG, the Swiss-based mining group – 41% owned by **Glencore International AG** – owns the other two vanadium producers, **Vantech** and **Rhovan**. These two operations supply about 15% of the world's vanadium production and are said to be very low-cost producers. Vantech operates the Kennedy's Vale vanadiferous magnetite mine in Mpumalanga Province and markets both pentoxide and ferrovanadium. The rated capacity of its operation is about 6000 t/y V_2O_5 and 2400 t/y FeV.

The **Rhovan** integrated operation at Ba Magopa mine in the North-West Province produces vanadium pentoxide from vanadiferous magnetite at a rated capacity of about 7000 t/y of V_2O_5. The mining operation, located near Brits in

Bophuthatswana, has proven and probable ore reserves of 90.6 Mt grading 1.97% V_2O_5, down to a depth of 60 m. In 2000, following the shift to export higher-valued vanadium products, Xstrata commissioned a 6000-t/y aluminothermic ferrovanadium facility to convert the V_2O_5 on site. This plant replaced the smaller facility at Vantech.

- **Russia** is reportedly now producing at less than 50% of its installed capacity of around 20 000 t/y of V_2O_5. Production of pentoxide in Russia is mainly from titanomagnetite and ilmenite deposits hosted in bedded mafic intrusive complexes located around Kachkanor and Sverlov in the Ural mountains, and in the Kola peninsula. Vanadium is mined at three main sites: Mount Kachkanar, Gusevogorsk and Pervoural'sk. The ore is converted to pig iron containing about 0.5% V_2O_5 at **the Nizhny Tagil Iron and Steel Works** and the **Chusovskoy Metallurgical Works** and is then further treated, producing slags containing 17-21% V_2O_5. These slags are then processed at the **Tulatchermet** (south of Moscow) and **Chusovskoy** plants to produce 50% and 80% ferrovanadium. The rest is exported to converters such as NIKOM, the Czech Republic-based ferrovanadium producer.

- In **Australia**, the Windimurra mine, commissioned in late 1999 by joint-venture partners **Precious Metals Australia (PMA)** and **Xstrata AG**, is reported to be the world's largest primary producer of vanadium pentoxide. Located near Mount Magnet in the Murchison District of Western Australia, the deposit is made up of vanadiferous magnetite-rich horizons hosted in a lateritic section of the Windimurra bedded mafic intrusive. It has reserves estimated at 106 Mt grading 0.47% V_2O_5. Now sole owner of the project after having acquired PMA's 49% interest in November 2000, Xstrata is reported to be operating Windimurra at close to its designed capacity of 7800 t/y of V_2O_5. In addition to the Windimurra deposit, Australia also has other potential sources of vanadium. These include the **Clough Resources'** Coates Ridge vanadium project near Wundowie in Western Australia, where a vanadiferous-magnetite deposit was mined between 1980 and 1982 but was closed after having delivered just over 300 t of V_2O_5. There is also the Julia Creek oil shale deposit in northeastern Australia's Queensland Province.

- The **United States'** production in 2001 is estimated at slightly less than 4000 t/y of contained vanadium, which came from eight firms primarily located in Arkansas, Louisiana, Texas and Utah. These firms produce a mixture of vanadium pentoxide, ferrovanadium, vanadium chemicals and vanadium metal by processing vanadium-bearing iron slag, fly ash, petroleum residues and spent catalysts. Most of this production is slated for domestic use.

  In late November 2001, led by Strategic Minerals Corp. (the largest U.S. producer of pentoxide) and by Shieldalloy Metallurgical Corp. (the largest U.S. producer of ferrovanadium), The Ferroalloys Association of the United States filed an anti-dumping petition with the U.S. Department of Commerce and the International Trade Commission (ITC) asking for the imposition of anti-dumping duties on imports of ferrovanadium from China and the RSA. The United States already has duties on ferrovanadium imports from Russia ranging from 3.75% to 108% - depending on the producing company - which date back to a 1994 petition. In the present case, the dumping margins estimated by U.S. producers are respectively 49-51% and 66-85%. The ITC made a provisional determination of the case in early January 2002 and is scheduled to announce the final results of its investigation by the end of May 2002. Industry insiders doubt that the imposition of duties will solve the structural problems plaguing the industry, which have resulted in over-production and a slump in prices. However, the imposition of duties would enable U.S. converters to preserve their conversion capabilities and give them some time to adjust to changing market conditions.

- **The People's Republic of China** is reported to be producing vanadium from the mining of titaniferrous magnetite deposits located mainly in the Sichuan and Anhui provinces in central and eastern China, and from slags imported from Russia, the RSA and New Zealand. The largest source, the Panzhihua iron ore mine in Sichuan, is said to host reserves estimated at 1.2 billion t grading 33.2% Fe_2O_3, 11.6% TiO_2 and 0.3% V_2O_5. Vanadiferous slags are also recovered from the Maanshaan Complex in the Anhui Province and from iron works in the Hubei and Chengde provinces. These slags are processed at seven plants for the production of vanadium pentoxide (total capacity of 8500 t/y V content), four of which have facilities to convert the material into ferrovanadium (total capacity of 4000 t/y V content).

- In **Japan**, falling ferrovanadium prices resulted in the October 2001 closure of the Uji plant, owned by Awamura Metal Industry Co., Ltd. (a subsidiary of Mitsui Co., Ltd.), and the August 2001 announcement by Nippon Denko of the transfer of its production at the Toyama plant to a joint-venture project with Highveld in the RSA.

PRICES

Historically, vanadium pentoxide prices have remained fairly stable except for two fairly recent price surges (Figure 3). The first one occurred between the last quarter of 1988 and the third quarter of 1990 while the second surge happened nearly 10 years later between early 1997 and the last quarter of 1998 with a peak in February 1998. The first surge resulted from a major increase in demand for ferrovanadium by the steel and aerospace industries while the second resulted from a tightening of supplies due to the process conversion of Russian suppliers. Owing to oversupplied markets, prices gradually slipped after the 1998 peak and are now testing historical lows (Figure 4). The entry of new capacity onto the market, such as Australia's Windimurra, exacerbated matters and forced the introduction of a price war. Prices for U.S. free market vanadium pentoxide stabilized in late 2000/early 2001 at a level of US\$1.35-\$1.40/lb V_2O_5, firmed up to reach a high of US\$1.50/lb V_2O_5 in mid-April 2001, and then continued their slide to close the year at around US\$1.10/lb V_2O_5.

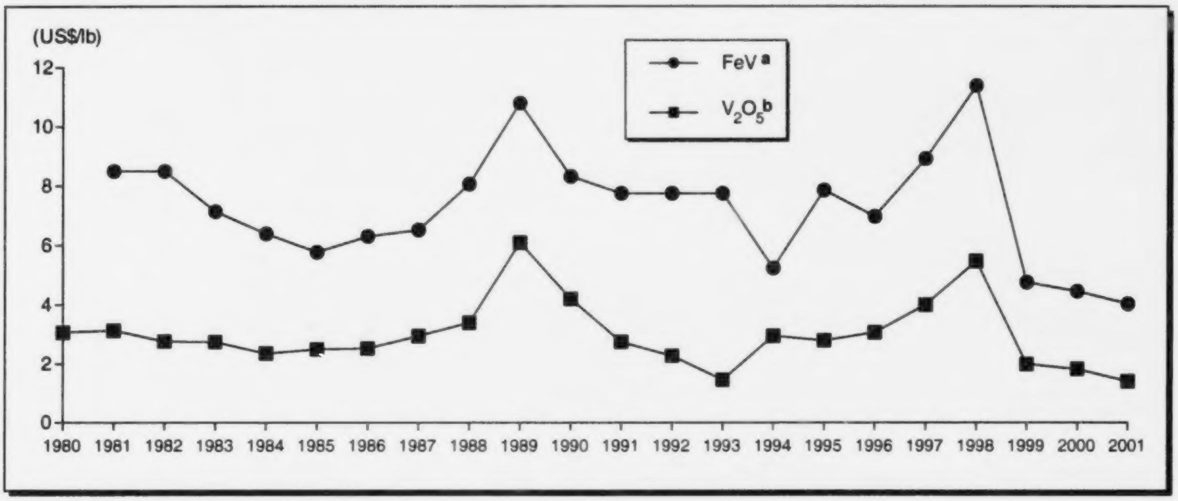
During the same period, ferrovanadium prices moved in a similar fashion. Free market ferrovanadium prices started the year in the range of US\$3.85-\$4.00/lb vanadium content for 80% V, reached a peak in the range of US\$4.00-\$4.50/lb in the second quarter of the year, and slid thereafter to finish the year at US\$3.60-\$3.80/lb.

OUTLOOK

The introduction by the United States of preliminary anti-dumping duties on imports of ferrovanadium from China and South Africa, as well as similar duties already in place on imports from Russia into the United States, increasing use in North America as it comes out of recession, and expected production cutbacks will help stabilize the market. However, the introduction of duties by the United States is not expected to resolve the basic market imbalance caused by the excess capacity in ferrovanadium production brought about by pentoxide producers aiming to market value-added products. In the short term, the duties will give the U.S. producers a bit of time to adjust to changing market conditions but the long-term trend we are witnessing, which is the availability of vanadium products at low prices, should eventually result in the closure of higher-cost capacity. A case in point is the recent closure of some of Japan's ferrovanadium capacity.

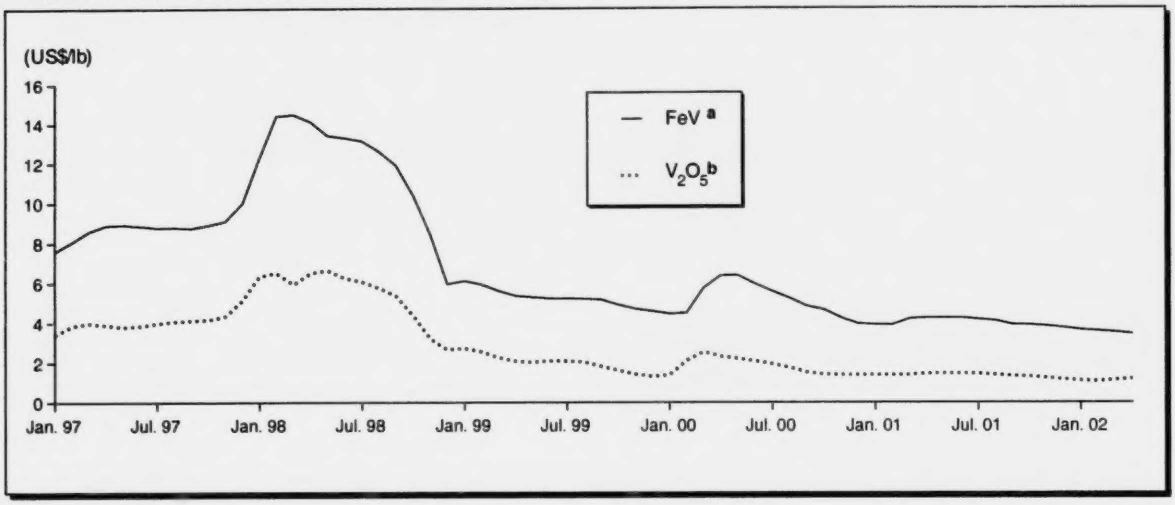
In the short and medium terms, the use of vanadium products is expected to increase further as a result of greater industrial activity in the recovering world economies and because of increasing use of vanadium per unit of steel in Asia, particularly in China, which is the world's fastest growing economy. Growth should centre around the steadily expanding steel industry, especially for structural shapes, tool steels, and automobile components. However, the recognition by markets of the potential use of vanadium in

Figure 3
Vanadium Products Price Variations, 1980-2001



Sources: *Metal Bulletin*, United States Geological Survey.
[a] Annual average price per pound of contained vanadium, U.S. producer. [b] Annual average price per pound V_2O_5, free market.

Figure 4
Vanadium Products Price Variations, 1997-2002



Source: *Metal Bulletin.*

[a] Price per pound of contained vanadium, U.S. free market 70-80% V in warehouse, Pittsburgh. [b] Price per pound V_2O_5, Europe, min. 98%.

redox batteries, as a convenient energy storage system, may create significant growth prospects for the industry over the short to medium term with corresponding pressure on prices. As in the past, the substitution of ferrovanadium by ferroniobium could start to take place in some applications if prices increase too much.

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of January 31, 2002. (3) This and other reviews, including previous editions, are available on the Internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

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TARIFFS

		Canada			United	E.U.	Japan (1)
Item No.	Description	MFN	GPT	USA	Canada	MFN	MFN
2825.30	Vanadium oxides and hydroxides	Free	Free	Free	Free	5.5%	Free
7202.92	Ferro-vanadium	2.5-6.5%	Free-5%	Free	Free	2.7%	2.5%

Sources: *Customs Tariff*, effective January 2002, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2002; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties for European Union* (41st Annual Edition: 2001); *Customs Tariff Schedules of Import Duties for Japan* (35th Annual Edition: 2001).

(1) GATT rate is shown; lower tariff rates may apply circumstantially.

TABLE 1. CANADA, VANADIUM IMPORTS AND EXPORTS, 1999-2001

Item No.		1999		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)	(tonnes)	($000)
EXPORTS							
2825.30	Vanadium oxides and hydroxides						
	United States	1	21	–	–	–	–
	Total	1	21	–	–	–	–
7202.92	Ferrovanadium						
	United States	564	9 276	388	4 578	304	2 984
	Trindad and Tobago	4	130	–	–	–	–
	Total	568	9 406	388	4 578	304	2 984
IMPORTS							
2825.30	Vanadium oxides and hydroxides						
	Australia	–	–	24	383	318	4 724
	South Africa	1 259	10 226	638	6 347	135	1 674
	United States	49	652	24	381	40	617
	Germany	. . .	6	1	35	4	80
	Other countries	–	4	1	15	8	146
	Total	1 308	10 888	688	7 161	505	7 241
7202.92	Ferrovanadium						
	Austria	33	415	65	747	39	552
	United States	213	3 525	154	2 260	49	618
	South Africa	303	4 344	287	3 718	324	3 226
	China	5	62	5	53	100	1 049
	Other countries	143	2 109	88	1 145	44	485
	Total	697	10 455	599	7 923	556	5 930

Source: Statistics Canada.

– Nil; . . . Amount too small to be expressed; (p) Preliminary.

Note: Numbers may not add to totals due to rounding.

Zinc

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The sharp drop in zinc prices that resulted from slowing demand and higher inventories in the face of increased production left many zinc producers in dire straits in 2001. In the last quarter of 2001 and in the wake of the tragic events in the United States on September 11, all indications were for a continuation of weak zinc prices and red ink on company balance sheets unless significant cuts in production were made and the demand for zinc and zinc products recovered. A number of significant announcement were made towards year-end, resulting in some optimism for 2002.

World zinc usage reached 8.7 Mt in 2001, according to preliminary figures from the International Lead and Zinc Study Group (ILZSG), a total that was 462 000 t less than total world refined zinc metal production of 9.2 Mt. Western World zinc demand exceeded production by 533 000 t. This supply deficit was offset, and indeed exceeded, by net exports of zinc metal totalling some 855 000 t to the West by Eastern countries. Zinc metal stocks held on the London Metal Exchange (LME) rose sharply through the year to end it at 433 000 t, a rise of 238 000 t since the end of 2000. Reported producer stocks were 44 000 t higher than at the end of 2000, totalling 360 000 t by year-end. Cash settlement prices on the LME reflected this oversupply in the market and averaged US$886.27/t in 2001, down 21% from 2000. Three-month prices averaged $904.25/t.

CANADIAN DEVELOPMENTS

2001 mine production:	$1.42 billion
World rank:	Second (metal production)
Exports:	$1.32 billion

Canada ranked second after China in terms of zinc metal production and third after China and Australia in terms of mine production in 2001 (Figure 3). Significant events in Canada in 2001 included the closure of the Sullivan mine in December, the temporary closure of Myra Falls in British Columbia, and the announcements of closures in 2002 to include the Nanisivik and Polaris mines in Nunavut and the Ruttan mine in Manitoba.

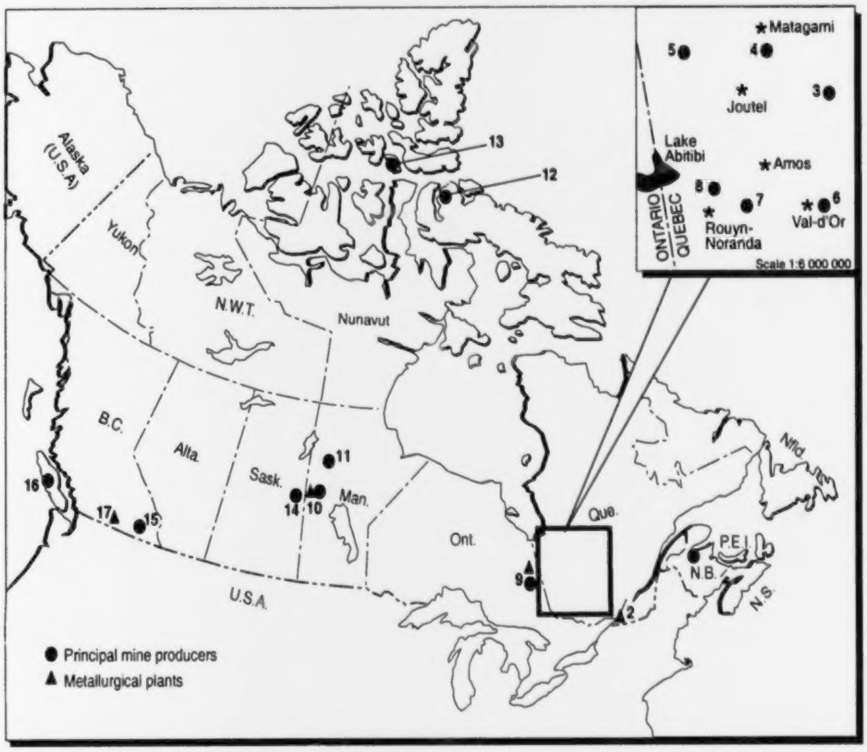
In terms of corporate events, Teck Corporation and Cominco Limited merged to create Teck Cominco Limited in July. Headquartered in Vancouver, it ranks as the fourth largest North American-based base-metals mining and refining company. In November, Boliden Limited shareholders approved the return of the company's headquarters from Toronto back to Stockholm, Sweden. Boliden moved to Toronto from Sweden in 1997.

Canada	1999	2000	2001
		(000 t)	
Mine production	1 021	936	1 009
Metal production	777	780	655
Usage	169	176	181

British Columbia

- Cominco Ltd. began a series of production cutbacks at its Trail smelter in southern British Columbia. Zinc production was reduced by about 100 000 t for the period December 2000 to October 2001. The cutbacks were part of a plan to allow for a fixed price power swap agreement with a major U.S. energy company. Zinc production at Trail resumed in October and reached full capacity of 300 000 t by the end of the month.
- On Friday, December 21, the Sullivan mine was closed after 92 years of active production. The mine produced more than $20 billion in lead, zinc and silver over its life and provided employment for more than four generations of miners in the

Figure 1
Zinc Producers in Canada, 2001


Alaska (U.S.A)
Yukon
N.W.T.
Nunavut
B.C.
Alta.
Sask.
Man.
Ont.
Que.
Nfld.
P.E.I.
N.B.
N.S.
U.S.A.
1
2
9
10
11
12
13
14
15
16
17
Matagami
5
4
3
Joutel
Lake Abitibi
Amos
8
7
6
Rouyn-Noranda
Val-d'Or
ONTARIO
QUEBEC
Scale 1:6 000 000
● Principal mine producers
▲ Metallurgical plants

Numbers refer to locations on map above.

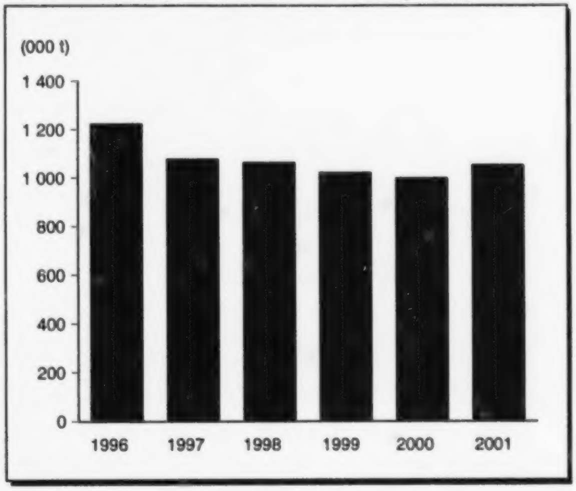
ZINC-PRODUCING MINES

			WEB SITE
1.	Brunswick	Noranda Inc.	www.noranda.com
3.	Langlois	Breakwater Resources Ltd. (on care-and-maintenance)	www.breakwater.ca
4.	Bell Allard	Noranda Inc.	www.noranda.com
5.	Selbaie	Les Mines Selbaie	www.bhpbilliton.com
6.	Louvicourt	Aur Resources Inc./Novicourt Inc.	www.aurresources.com
7.	LaRonde	Agnico Eagle Mines Limited	www.agnico-eagle.com
8.	Bouchard-Hébert	Breakwater Resources Ltd.	www.breakwater.ca
9.	Kidd Creek	Falconbridge Limited	www.falconbridge.com
10.	Callinan	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	Trout Lake	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	Chisel North	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
	777	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
11.	Ruttan	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
12.	Nanisivik	Breakwater Resources Ltd.	www.breakwater.ca
13.	Polaris	Teck Cominco Limited	www.teckcominco.com
14.	Konuto Lake	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
15.	Sullivan	Teck Cominco Limited (closed December 2001)	www.teckcominco.com
16.	Myra Falls	Boliden Limited	www.boliden.ca

ZINC METALLURGICAL PLANTS

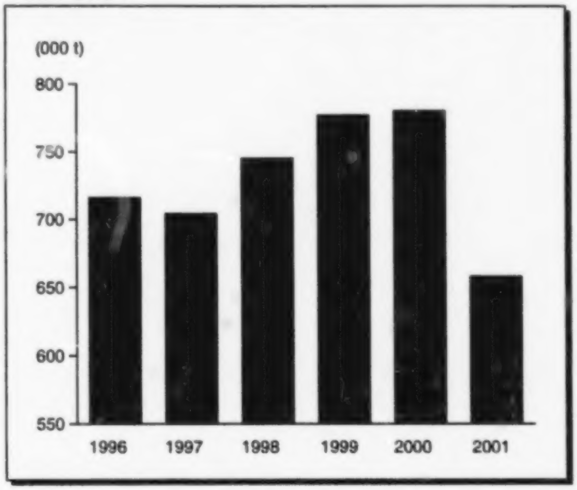
2.	Valleyfield	Canadian Electrolytic Zinc Limited	www.noranda.com
9.	Kidd Creek	Falconbridge Limited	www.falconbridge.com
10.	Flin Flon	Hudson Bay Mining and Smelting Co., Limited	www.angloamerican.co.uk
17.	Trail	Teck Cominco Limited	www.teckcominco.com

Figure 2
Canadian Mine Production of Zinc, 1996-2001



Source: Natural Resources Canada.

Figure 3
Canadian Refined Zinc Metal Production, 1996-2001



Source: Natural Resources Canada.

Kimberley region. Teck Cominco started an extensive decommissioning and reclamation process at the site.

- Boliden Limited announced that it would temporarily suspend operations for three months, starting in December, at its Myra Falls mine in British Columbia due to low metal prices. The temporary closure at Myra Falls resulted in the loss of about 30 000 t of zinc in concentrates. In addition to the temporary closure, the company announced that it was exploring the possibility of selling the mine.

Yukon

- In September, Expatriate Resources Ltd. informed Teck Cominco Metals Ltd. that it would not be making the $1 million payment due under the Asset Sale Agreement for the acquisition of the Kudz Ze Kayah property. Upon termination of the agreement, Expatriate ceased to have any interest in the Kudz Ze Kayah property, located in the Finlayson Lake District of southeastern Yukon. Expatriate maintains its 60% ownership in the adjacent Wolverine joint venture together with Atna Resources Ltd.

Saskatchewan/Manitoba

- Hudson Bay Mining & Smelting Co., Limited (HBMS) completed work on a new zinc tank house at the Flin Flon smelter, increasing capacity by 15% to 115 000 t/y. The project was completed in October, three months ahead of schedule.

- HBMS announced the permanent closure of the Ruttan mine in Manitoba for the end of May 2002. Ruttan supplies concentrates for the Flin Flon smelter.

Nunavut

- In October, Breakwater Resources Limited announced the accelerated closure of the Nanisivik mine in Nunavut. The mine will be closed in September 2002. The company cited continued weak metal prices as the primary reason for accelerating the mine's closure.

- The Department of Indian Affairs and Northern Development announced that the federal government will provide $3 million as part of the funding to determine the feasibility of constructing a road and port in the Kitikmeot region of Nunavut. The Government of Nunavut and industry will contribute a further $3 million. The proposed road would extend approximately 295 km from a port site on the Bathurst Inlet to Inmet Mining Corporation's Izok zinc and copper deposit. The Izok deposit has an indicated resource of 16.5 Mt grading 11.4% zinc, 2.2% copper and 60 g/t silver. The project's isolation from any major transportation routes and the general lack of infrastructure to the area pose significant economic challenges in the further development of the project.

Ontario

- Falconbridge Limited's Kidd Mining Division in Timmins, Ontario, temporarily reduced production in the first quarter of 2001 due to ground movement that occurred at the No. 1 mine in late December 2000.

- At the Kidd Metallurgical Division, zinc production was down slightly due to the lower mine production and the lack of replacement feed in the short term. Falconbridge announced that development of Mine D at Kidd was progressing on budget. Production from Mine D is now expected to start in 2004.

Quebec

- Breakwater Resources Ltd. released the results of its Langlois feasibility study in September. Operations at the Langlois mine, located near Lebel-sur-Quévillion, were suspended in November 2000 when problems associated with the main ore pass system, combined with low metal prices, made it uneconomic to operate. Approximately 18 months of construction and development work is required before the mine can resume full production. The decision to re-open the mine is dependent upon improved zinc prices.

Newfoundland and Labrador

- Aur Resources Inc. entered into an agreement to purchase the Duck Pond copper-zinc project near Buchans in west-central Newfoundland from joint-venture partners Thundermin Resources Inc. and Queenston Mining Inc. Thundermin and Queenston hold their interest in the project under an option agreement with Noranda Mining and Exploration Inc. A detailed feasibility study on the project was completed in May. The project contains combined proven and probable mineral reserves in two deposits totalling 5.2 Mt grading 3.3% copper, 5.8% zinc, 0.9% lead, 59 g/t silver and 0.8 g/t gold.

WORLD DEVELOPMENTS

World	1999	2000	2001
		(000 t)	
Mine production	8 026	8 744	8 876
Metal production	8 369	8 939	9 207
Usage	8 392	8 863	8 745

Despite the low world prices for zinc in 2001, several new or expansion projects came on stream during the year, most notably the new Antamina mine in Peru and the Francisco Madero mine in Mexico. Significant closures announced in 2001 included the temporary shut-down of the Tara mine in Ireland and the Los Frailes mine in Spain. Projects under consideration that were put back on the shelf included the Gamsberg project in South Africa. Mine output in Australia and Ireland continued to expand, mainly as a result of further gains at the Century and Lisheen mines. Further increases were also anticipated in China where production is dependent on a huge number of small mines spread throughout the country.

In terms of significant corporate events, Australia's BHP Limited and London-based Billiton plc announced a merger to create BHP Billiton. Elsewhere, Pasminco Limited was placed into voluntary administration in September in an attempt to restructure the company's debt of over A$3.4 billion. In addition to operations in Australia, Pasminco owns and operates facilities in the Netherlands and the United States.

United States

- Asarco Incorporated, a wholly owned subsidiary of Grupo México S.A. de C.V., announced that it would suspend its zinc mining and processing operations in the state of Tennessee in November due to low metal prices.

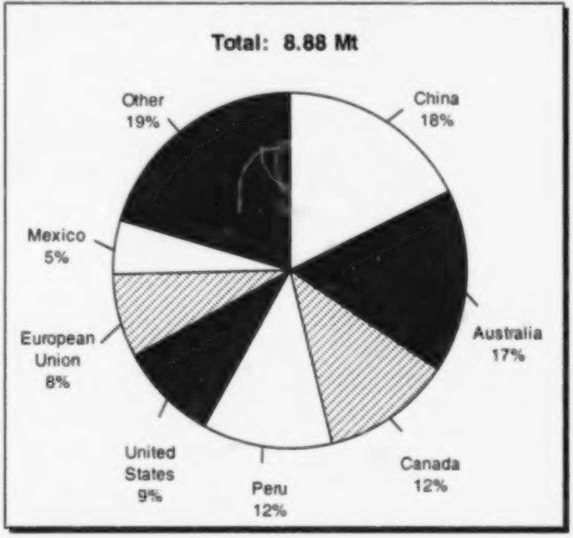
- Teck Cominco Limited announced further positive drilling results near the Red Dog mine, owned by its wholly owned affiliate, Teck Cominco American Incorporated. The Anarraaq deposit, 10 km north of the Red Dog mine, was discovered by drill-testing a gravity anomaly in 1999. Drilling in 2000 established an inferred resource of 17.2 Mt grading 15.8% zinc, 4.8% lead and 17 g/t silver. A further eight drill holes were completed on this large gravity anomaly during the 2001 field season.

Mexico

- Industrias Peñoles, S.A. de C.V. opened the Francisco I Madero zinc mine in the Mexican state of Zacatecas in September. The mine will operate with a production capacity of 110 000 t/y of zinc in concentrates. The mine, located in north-central Zacatecas, represents a US$127 million investment and adds 1.6 Mt to Peñoles' current zinc reserves of 1.8 Mt.

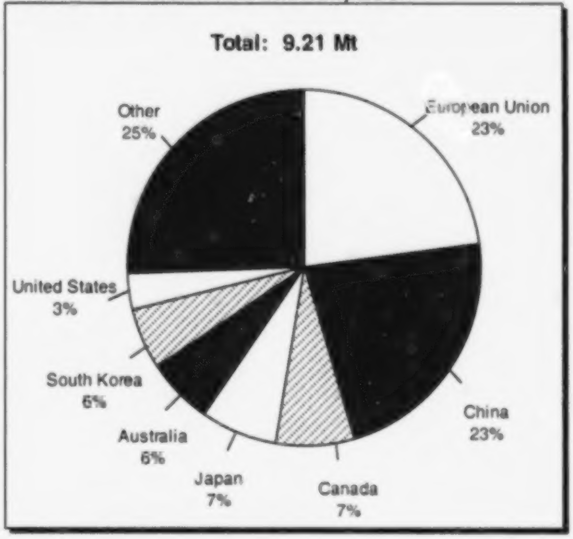
- Elsewhere in Mexico, weak zinc prices and the strength of the Mexican peso led Dowa Mining to temporarily suspend production at the Minera Rey de Plata lead-zinc mine in Guerrero State in

Figure 4
World Zinc Mine Production, 2001



Source: International Lead and Zinc Study Group.

Figure 5
World Zinc Metal Production, 2001



Source: International Lead and Zinc Study Group.

December. Minera Rey de Plata, owned 51% by Mexico's Mina Peñoles SA, 39% by Dowa Mining and 10% by Sumitomo Corp., began operations in 1997 to supply concentrates to the Akita Zinc smelter in Japan. Minera Rey de Plata made its first commercial shipment to Akita Zinc in February.

South America

- Noranda Inc., Teck Cominco Limited, BHP Billiton Plc and Mitsubishi Corporation announced that the Antamina copper-zinc project in northern Peru had achieved commercial production in October, more than four months ahead of the original schedule of February 2002. In December, the first shipments of zinc concentrate were sent to Japan and South Korea. Additional shipments were sent to Europe, Japan and South Korea before year-end.

- In November, Teck Cominco Metals Limited signed a memorandum of understanding providing for exclusive negotiations with Paranapanema S.A. of Brazil for the purchase of Paraibuna de Metais, Brazil's second largest zinc producer. Paraibuna de Metais operates a 90 000-t/y zinc refinery near Juiz de Fora, northwest of Rio de Janeiro. The refinery's production capacity was reduced earlier in 2001 to a rate of 47 000 t/y as a result of Brazil's electricity rationing scheme. The company reduced output to sell energy from its Sobragi hydro-electric plant onto the Brazilian market. Full production resumed in December.

Europe

- In November, Finland's Outokumpu Oyj announced that is was getting out of the base-metal mining business. The company will focus its efforts on metal production, fabrication and technology. At the same time, the company announced that it was placing its Tara zinc mine in Ireland on care and maintenance, pending better zinc prices. Tara is the largest zinc mine in Europe and produces nearly 200 000 t/y of zinc in concentrate.

- Outokumpu commissioned the €31 million expansion of its zinc plant in Kokkola, Finland, raising the refinery's capacity by 35 000 t to 260 000 t/y. Together with the acquisition of the Norzink AS refinery in April and the completion of the Kokkola expansion, Outokumpu now has a 15% share of zinc production capacity in Europe.

- In December, Toronto-based Inmet Mining Corporation and Outokumpu entered into an alliance agreement. As part of the agreement, Inmet will purchase Outokumpu's Pyhäsalmi copper-zinc mine in Finland for €4 million in cash, a €14 million, 10-year, 6% promissory note, and four million Inmet common shares. Inmet will also receive a number of Outokumpu's exploration properties in

Finland. The companies also entered into a life-of-mine off-take agreement for copper and zinc concentrates from Pyhäsalmi. The mine produces 30 000 t/y of zinc in concentrate and is expected to operate until 2015.

- Vancouver-based EuroZinc Mining Corporation signed an agreement with the Portuguese-owned mining company, Empresa de Desenvolvimento Mineiro, SGPS, S.A., to buy the company's controlling interest in Pirites Alentejanas, S.A., the operating company that owns the Aljustrel zinc project. EuroZinc will pay a total of US$5.4 million to acquire the company's 75% stake in Pirites Alentejanas. The purchase includes operating permits, mill facilities, underground development, offices, machine shops, stocked warehouses, and a dedicated port facility.

- In October, Boliden Apirsa, the Spanish mining division of Boliden Ltd., announced the closure of its Los Frailes lead-zinc mine in Aznalcollar, Spain. In November, a judicial investigation cleared Boliden Apirsa of responsibility for a major tailings dam failure that occurred in April 1998. The accident was caused by mistakes in the design and erroneous conclusions of the geological studies that were carried out prior to construction of the tailings dam and were not attributed to the Apirsa operations.

- Australian-based MIM Holdings Limited announced that it was seeking opportunities to sell its zinc smelting operations in the United Kingdom and Germany. MIM owns the Britannia Zinc Limited zinc-lead smelter/refinery complex at Avonmouth, U.K., and the M.I.M. Huttenwerke Duisburg GmbH zinc-lead smelter/refinery at Duisburg, Germany. Britannia Zinc produced 78 000 t of zinc in 2000/01 from a variety of mine sources and recycling feedstock, including mixed lead-zinc concentrate from MIM's McArthur River mine in Australia. The Duisburg plant also processes feedstock from a variety of mines and increasingly from recycled sources. It produced 90 000 t of zinc in 2000/01.

Asia

- Inmet entered into an agreement with Gama Endüstri to purchase its 6% interest in the Çayeli copper-zinc mine in Turkey for approximately $13 million. The purchase of Gama's interest will increase Inmet's ownership in Çayeli to 55% and is subject to government approval. The Çayeli mine is located in Rize Province in eastern Turkey and produces approximately 40 000 t of zinc metal annually.

Africa

- In July, Anglo American plc postponed development of its Gamsberg zinc deposit in South Africa due to economic uncertainty and low zinc prices.

- In December, the European Investment Bank announced that it is lending €35 million to state-owned Namibia Power Corp. for the construction of power transmission lines to the new Skorpion zinc mine in the southwestern part of the country. Skorpion is the largest private-sector investment in the country and the project will improve the reliability of electricity supply to the mine.

- Toronto-based Breakwater Resources withdrew from a plan to develop the Oued Amiziour zinc project in Algeria. Breakwater signed a letter of intent with the Algerian government in April 2000, but cited a new law that spells the end to a five-year tax-free period and preferential transport rates as the reason for withdrawing from the project.

Australia

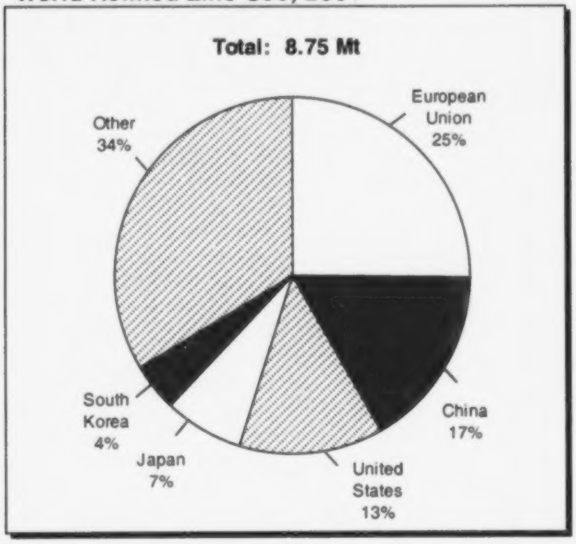
- Pasminco Limited was placed into voluntary administration in September in an attempt to restructure the company's debt of over A$3.4 billion. As part of the restructuring, the new Century zinc mine in Queensland was put up for sale. By year-end, however, the administrator applied for and received permission from the Australian Federal Court to reschedule the next meeting of creditors from January 7, 2002, to April 7, 2002, deferring the sale of the mine.

- On June 29, 2001, Melbourne-based BHP Limited and London-based Billiton Plc merged to form BHP Billiton. The new company is a significant producer of aluminum, metallurgical coal, seaborne steaming coal, copper, ferro-alloys, iron ore, and titanium minerals. The group also has substantial worldwide interests in oil, gas, liquefied natural gas, nickel, diamonds and silver. BHP Billiton maintains its headquarters in Melbourne, Australia, with a significant corporate management centre in London. In terms of Canadian zinc assets, the new company owns a 100% interest in the Selbaie copper-zinc mine in northern Quebec and a 25% interest in the Polaris mine in Nunavut.

ZINC DEMAND

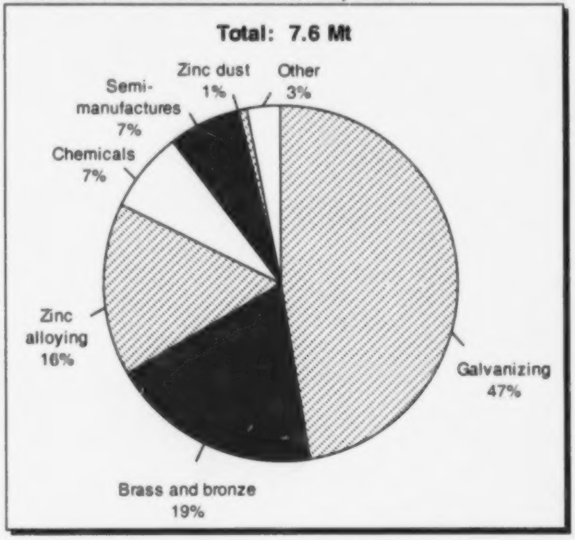
World zinc demand fell in 2001 by about 1.3% after eight consecutive years of growth to 8.7 Mt. Preliminary figures from ILZSG for 2001 indicate that Western World demand decreased from 7.0 Mt in 2000 to

Figure 6
World Refined Zinc Use, 2001



Source: International Lead and Zinc Study Group.

Figure 7
Western World Zinc Markets, 2000



Source: International Lead and Zinc Study Group.

just over 6.7 Mt in 2001 (Figure 6). The main reason for the decline in world demand came from a 13.5% decline in the United States. European demand fell by just under 1%. In contrast to the decline elsewhere in the world, zinc demand in China grew by some 9.6% to over 1.4 Mt in 2001. In Canada, zinc use from both primary and recycled sources rose from a reported 143 000 t in 2000 to just under 148 000 t in 2001.

In terms of zinc markets, the galvanic protection of steel continues to represent the predominant end use of zinc, accounting for some 47% of zinc usage in 2000. Zinc is used extensively in the automotive and construction industries for corrosion protection and remains one of the most cost-effective means of protecting steel against corrosion. The manufacture of brass and bronze is the second most important use of zinc, accounting for 19% of usage followed by zinc-based alloys for die-cast products at 16% of all uses in 2000.

The remaining zinc is used for oxides and other chemicals and zinc dust. Zinc oxide has a variety of applications, the most important of which is as an accelerator in the curing of rubber. High-purity zinc oxide is used in the pharmaceutical industry and zinc oxide-based salves and ointments have long been known for their healing properties. Other grades are used in the zinc plating industry, as an anti-corrosion agent in lubricants, and in paints, animal feeds and a variety of chemicals (Figure 7).

Recycled zinc includes high-purity zinc refined from the treatment of electric arc furnace (EAF) dusts, remelted zinc with a purity less than 98.5% zinc, and scrap zinc used in the production of zinc alloys. According to ILZSG, the amount of recycled zinc recovered in the Western World has risen steadily in recent years, reaching 2.1 Mt in 2001.

INTERNATIONAL LEAD AND ZINC STUDY GROUP

The International Lead and Zinc Study Group was formed in 1959 to improve market information and to provide opportunities for regular intergovernmental consultations on issues related to lead and zinc markets. Particular attention is given to providing regular and frequent information on the supply, demand and outlook for lead and zinc.

The Study Group, headquartered in London, England, comprises 28 countries representing most of the world's major lead- and zinc-producing and using nations. The Group has an extensive information-gathering and dissemination role and acts as an effective mechanism for increasing market transparency related to the production, use and trade of lead and zinc. The Group is also an important forum for communication among governments, among industry, and between governments and industry. It holds a general session each year in October. Canada has been an active member of the Group since its inception.

The 46th Session of the Study Group was held in New Delhi, India, in October 2001 and was attended by some 85 registered participants, including representatives of 23 member countries and observers from several invited nations, industry and non-governmental organizations. As part of the work of the Group's Economic and Environment Committee, two new reports will be published in 2002: *The Use of Zinc in Construction and Public Works* and *The Use of Lead and Zinc in Chemicals*. Work is also continuing on a joint Study Group (Lead and Zinc, Copper, and Nickel) workshop on recycling to be held sometime in 2003.

The Group continues to work on updating its capacity to deliver, through electronic means, its monthly statistical bulletin. The monthly bulletin is now available to member countries and subscribers on-line through the Group's web site. The development of an interactive version of the bulletin and other improvements to the site continue. The Study Group will hold its next Annual Session and meetings of its Committees and Industry Advisory Panel in Stockholm, Sweden, from October 4 to 6, 2002.

More information about the Group's activities and the availability of a wide range of publications pertaining to lead and zinc can be obtained from its web site at www.ilzsg.org. For information on the Group's activities in partnership with the International Copper Study Group and the International Nickel Study Group related to the contribution nonferrous metals make to sustainable development and the Non-Ferrous Metals Consultative Forum, visit the joint web site at www.nfmsd.org.

PRICES AND STOCKS

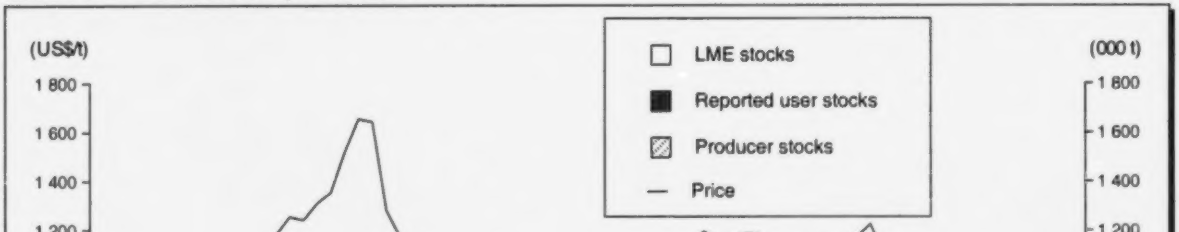
After maintaining a cash settlement price of around US$1050/t on the London Metal Exchange (LME) in the first quarter of 2001, zinc prices followed a steady downward trend, reaching record lows of $732.50/t in mid-December. Prices bounced back slightly to end the year at $767.50/t. As a result of this sharp decline in prices, a number of zinc producers fell under severe financial pressure with no near-term relief for price increases expected.

While user stocks remained relatively constant over the year, stocks on the LME rose sharply at the start of the year from just over 300 000 t and continued a steady climb to end the year at 433 350 t. Prices reflected the oversupply in the market and averaged US$886.27/t in 2001 (Figures 8 and 9).

OUTLOOK

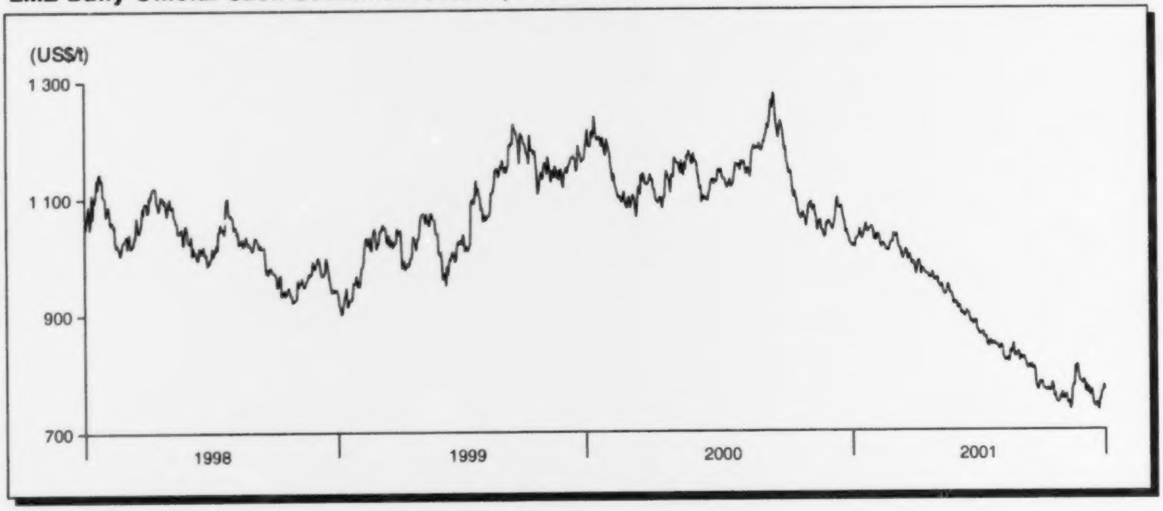
Canadian mine production of zinc overall is expected to decrease by about 13% in 2002 as a result of the closure of the Sullivan mine and the suspension of operation at Myra Falls mines in December 2001 and

Figure 8
Zinc Prices and Stocks, 1996-2001



Source: International Lead and Zinc Study Group.

Figure 9
LME Daily Official Cash Settlement Prices, 1998-2001



Source: London Metal Exchange.

the scheduled closure of the Polaris, Nanisivik and Ruttan mines in the second half of 2002. No new mine capacity is due to come on stream to replace these closures.

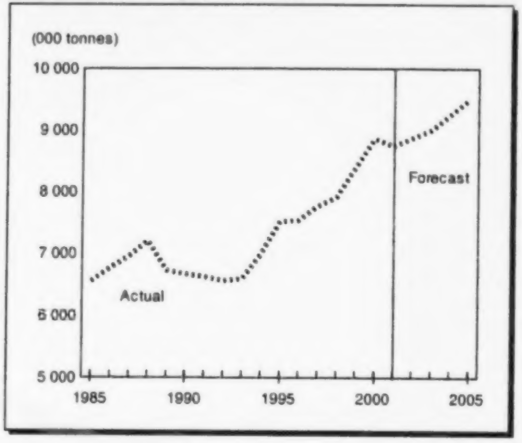
For 2002, the zinc market, according to information gathered by the member countries of the ILZSG, is expected to result in a substantial Western World market surplus if ambitious production targets are achieved. Overall, after taking into consideration releases from the U.S. Defense National Stockpile, the ILZSG envisaged a substantial surplus of refined metal supply over demand in 2002. The Group acknowledged that the scale of the surplus, estimated at about 500 000 t, could be reduced if present production plans are curtailed as a consequence of low market price levels. These concerns related to a large surplus in 2002 were, however, allayed somewhat by production cuts announced late in 2001. Prices are expect to remain weak, averaging about $850/t in 2002. Continued growth in galvanizing markets, combined with a gradual recovery in overall markets, is expected, with zinc prices rising to US$1000-$1100/t by 2005 (Figures 10 and 11).

Notes: (1) For definitions and valuation of mineral production, shipments and trade, please refer to Chapter 64. (2) Information in this review was current as of May 31, 2002. (3) This and other reviews, including previous editions, are available on the internet at www.nrcan.gc.ca/mms/cmy/index_e.html.

NOTE TO READERS

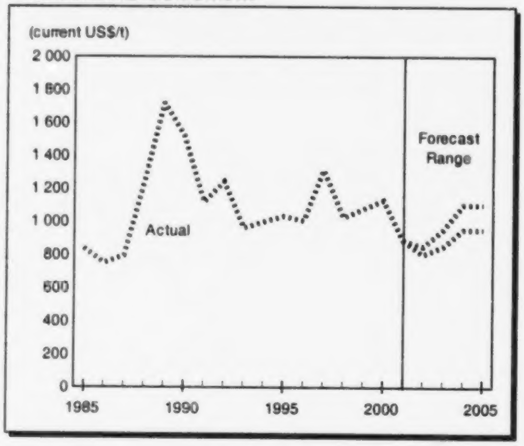
The intent of this document is to provide general information and to elicit discussion. It is not intended as a reference, guide or suggestion to be used in trading, investment, or other commercial activities. The author and Natural Resources Canada make no warranty of any kind with respect to the content and accept no liability, either incidental, consequential, financial or otherwise, arising from the use of this document.

Figure 10
World Zinc Usage, 1985-2005



Sources: Natural Resources Canada; International Lead and Zinc Study Group.

Figure 11
Average Cash Settlement Zinc Prices, 1985-2005
Annual LME Settlement



Source: Natural Resources Canada.

TARIFFS

Item No.	Description	Canada			United States	EU (1)	Japan (2)
		MFN	GPT	USA	Canada	MFN	WTO
2603.00	Copper ores and concentrates						
2603.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2607.00	Lead ores and concentrates						
2607.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2608.00	Zinc ores and concentrates						
2608.00.00.30	Zinc content	Free	Free	Free	Free	Free	Free
2616.10	Silver ores and concentrates						
2616.10.00.30	Zinc content	Free	Free	Free	Free	Free	Free
26.20	Ash and residues (other than from the manufacture of iron or steel) containing metals or metal compounds containing mainly zinc						
2620.11	Hard zinc spelter	Free	Free	Free	Free	Free	Free
2817.00	Zinc oxide; zinc peroxide	Free-6.5%	Free	Free	Free	7.2%	4.3%
28.33	Sulphates; alums; peroxosulphates (persulphates)						
2833.26	Of zinc	Free	Free	Free	Free	5.5%	3.9%
79.01	Unwrought zinc						
	Zinc, not alloyed:						
7901.11	Containing by weight 99.99% or more of zinc	Free	Free	Free	Free	2.5%	4.30 yen/kg
7901.12	Containing by weight less than 99.99% of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7901.20	Zinc alloys:						
7901.20.00.10	Containing by weight 90% or more but less than 97.5% of zinc	Free	Free	Free	Free	2.5%	4.30 yen/kg
7901.20.00.20	Containing by weight less than 90% of zinc	Free	Free	Free	Free	2.5%	Free-4.30 yen/kg
7902.00	Zinc waste and scrap	Free	Free	Free	Free	Free	Free
79.03	Zinc dust, powders and flakes						
7903.10	Zinc dust	Free	Free	Free	Free	2.5%	3%
7903.90	Other	Free	Free	Free	Free	2.5%	3%
7904.00	Zinc bars, rods, profiles and wires	Free	Free	Free	Free	5%	3%
7905.00	Zinc plates, sheets, strip and foil	Free	Free	Free	Free	5%	3%
7906.00	Zinc tubes, pipes, and tube or pipe fittings (for example, couplings, elbows, sleeves)	3%	Free	Free	Free	5%	3%
7907.00	Other articles of zinc						
7907.00.10	Anodes for electroplating	Free	Free	Free	Free	5%	3%
7907.00.20	Discs or slugs, containing by weight 90% or more of zinc; gutters, roof capping, skylight frames and other fabricated building components	3%	Free	Free	Free	5%	3%
7907.00.90	Other	3%	3%	Free	Free	5%	3%

Sources: *Customs Tariff*, effective January 2001, Canada Customs and Revenue Agency; *Harmonized Tariff Schedule of the United States*, 2001; *Worldtariff Guidebook on Customs Tariff Schedules of Import Duties of the European Union* (41st Annual Edition, 2001); *Customs Tariff Schedules of Japan*, 2000.
(1) Duty suspension may apply for certain goods. (2) WTO rate is shown; lower tariff rates may apply circumstantially.
Note: Where there is a tariff "range," a complete match of the HS code was not available; therefore, the high and low for the product in question are shown.

TABLE 1. CANADA, ZINC PRODUCTION AND TRADE, 2000 AND 2001, AND USE, 1998-2000

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
PRODUCTION					
	All forms (1)				
	New Brunswick	237 535	397 871	305 874	429 141
	Quebec	214 876	359 917	258 045	362 037
	Ontario	71 594	119 919	74 439	104 437
	Manitoba	79 904	133 839	93 500	131 180
	Saskatchewan	1 104	1 849	1 198	1 680
	British Columbia	145 516	243 740	110 161	154 556
	Nunavut	185 185	166 355	166 355	233 395
	Total	935 713	1 567 320	1 009 571	1 416 428
	Mine output (2)	1 002 242	. . .	1 070 294	. . .
	Refined (3)	779 892	. . .	654 562	. . .
EXPORTS					
2603.00.30	Zinc content in copper				
	Belgium	–	–	–	–
	Italy	2 029	1 319	–	–
	Japan	5 728	4 280	–	–
	Total	7 757	5 599	–	–
2608.00.30	Zinc content in zinc ores and concentrates				
	Belgium	62 540	66 942	116 414	83 777
	Finland	45 797	65 902	55 279	54 054
	Spain	31 398	35 453	67 622	53 142
	Sweden	40 084	69 482	41 342	51 910
	Norway	12 836	21 429	25 844	26 704
	Germany	21 337	31 780	22 275	22 818
	Italy	14 492	22 590	18 302	14 580
	South Korea	–	–	27 468	13 716
	Japan	45 278	38 782	31 964	12 820
	Poland	3 657	3 010	13 188	6 305
	Bulgaria	–	–	5 243	4 222
	Other countries	41 731	45 165	29 914	17 130
	Total	319 150	400 534	454 855	361 178
2620.11	Ash and residues containing hard zinc				
	United States	–	–	161	119
	India	21	15	–	–
	Total	21	15	161	119
2620.19	Ash and residues containing mainly zinc, n.e.s.				
	United States	7 838	7 277	7 728	5 942
	India	84	82	256	195
	Japan	40	42	21	23
	Greece	–	–	–	–
	South Africa	102	124	–	–
	Total	8 064	7 525	8 005	6 160
2817.00	Zinc oxide; zinc peroxide				
	United States	44 007	72 848	47 548	71 160
	Norway	238	410	531	762
	Italy	331	423	502	589
	Australia	625	333	440	500
	France	73	442	281	365
	Other countries	412	770	508	703
	Total	45 686	75 226	49 810	74 079
2833.26	Zinc sulphate				
	United States	23	41	208	216
	Total	23	41	208	216

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
EXPORTS (cont'd)					
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc				
	United States	350 279	631 763	304 103	474 992
	Netherlands	–	–	10 503	14 725
	Taiwan	6 287	10 871	2 772	6 435
	Indonesia	2 985	5 201	3 920	6 164
	Hong Kong	4 174	7 397	3 830	5 578
	Singapore	3 386	5 969	1 469	2 379
	Malaysia	4 864	8 651	1 171	1 605
	Philippines	3 675	6 267	420	566
	Other countries	1 052	1 821	81	106
	Total	376 702	677 908	328 269	512 550
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc				
	United States	187 224	332 981	146 183	226 684
	Hong Kong	9 064	17 491	6 550	11 451
	Indonesia	4 799	8 772	4 702	7 598
	Japan	4 544	8 230	4 493	6 914
	New Zealand	4 658	7 608	1 198	4 443
	Philippines	3 429	5 643	1 793	2 924
	Sri Lanka	645	1 162	567	939
	Malaysia	3 289	5 814	457	672
	Other countries	8 272	14 864	993	1 648
	Total	225 924	402 565	166 936	263 273
7901.20	Zinc alloys, unwrought				
	United States	1 734	3 345	1 823	2 709
	Total	1 734	3 345	1 823	2 709
7902.00	Zinc waste and scrap				
	United States	33 547	22 705	37 446	16 844
	Hong Kong	–	–	2 025	2 100
	Taiwan	2 400	2 366	410	418
	Other countries	461	367	469	366
	Total	36 408	25 438	40 350	19 728
7903.10	Zinc dust				
	United States	5 287	12 915	6 086	6 086
	Other countries	62	99	19	19
	Total	5 349	13 014	6 105	6 105
7903.90	Zinc powders and flakes				
	United States	8 339	24 466	8 016	19 463
	Other countries	587	1 038	763	1 103
	Total	8 926	25 504	8 779	20 566
7904.00	Zinc bars, rods, profiles and wire				
	United States	152	679	190	1 058
	Other countries	–	–	2	6
	Total	152	679	192	1 064
7905.00	Zinc plates, sheets, strip and foil				
	France	–	–	32	174
	United States	10	99	6	64
	Spain	–	–	–	–
	Total	10	99	38	238
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)				
	United States	1 176	8 084	1 097	8 509
	Other countries	2	36	–	–
	Total	1 178	8 120	1 097	8 509
	Total exports	1 037 084	1 645 612	1 066 628	1 284 189

TABLE 1 (cont'd)

Item No.		2000		2001 (p)	
		(tonnes)	($000)	(tonnes)	($000)
IMPORTS					
2603.00.00.30	Zinc content in copper ores and concentrates	3	3	–	–
2607.00.00.30	Zinc content in lead ores and concentrates	3 149	2 614	5 031	4 904
2608.00.00.30	Zinc content in zinc ores and concentrates	207 676	128 115	140 465	91 534
2616.10.00.30	Silver ores and concentrates	20 889	17 275	8 514	6 494
2620.11	Ash and residues containing hard zinc	25	46	–	–
2620.19	Ash and residues containing mainly zinc, n.e.s.	1 518	1 767	572	338
2817.00	Zinc oxide; zinc peroxide	7 519	10 525	11 290	15 237
2833.26	Zinc sulphate	5 659	3 954	6 245	4 426
7901.11	Zinc, not alloyed, unwrought, containing by weight 99.99% or more of zinc	3 155	5 267	6 121	8 990
7901.12	Zinc, not alloyed, unwrought, containing by weight less than 99.99% of zinc	3 484	5 516	336	495
7901.20	Zinc alloys, unwrought	7 870	15 194	4 844	9 562
7902.00	Zinc waste and scrap	408	393	302	244
7903.10	Zinc dust	5 020	10 308	5 536	10 388
7903.90	Zinc powders and flakes	588	1 191	428	723
7904.00	Zinc bars, rods, profiles and wire	8 664	15 315	2 607	5 252
7905.00	Zinc plates, sheets, strip and foil	1 124	4 701	1 697	6 214
7906.00	Zinc tubes, pipes and tube or pipe fittings (for example, couplings, elbows, sleeves)	1 764	12 363	1 149	8 222
7907.00	Other articles of zinc	7 195	28 445	4 944	19 309
	Total imports	285 710	262 992	200 081	192 332

	1998			**1999** (a)			**2000** (p) (a)		
	Primary	**Recycled**	**Total**	**Primary**	**Recycled**	**Total**	**Primary**	**Recycled**	**Total**
					(tonnes)				
QUANTITY USED (5) (6)									
Zinc used for or in the production of:									
Copper alloys (brass, bronze, etc.)	x	x	2 987	x	x	2 395	x	x	2 847
Galvanizing: electro	x	x	2 662	x	x	2 472	x	x	2 335
hot dip	x	x	76 208	x	x	75 716	x	x	73 568
Zinc die-cast alloys	x	x	27 402	x	x	29 550	x	x	31 105
Other products (including rolled and ribbon zinc, zinc oxides, electroplating)	x	x	29 164	x	x	33 055	x	x	38 057
Total	137 610	814	138 424	142 451	737	143 188	136 544	11 369	147 913
User stocks, year-end	8 994	59	9 053	12 175	89	12 264	7 834	938	8 772

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; n.e.s. Not elsewhere specified; (p) Preliminary; x Confidential.
(a) Increase in number of companies being surveyed.
(1) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. (2) Zinc content of ores and concentrates produced. (3) Refined zinc produced from domestic and imported ores. (4) Includes HS classes 2603.00.30, 2607.00.30 and 2616.10.30. (5) User survey does not represent all Canadian users and is therefore consistently less than the apparent quantity used. (6) Due to confidentiality in some end-use categories, a breakdown of primary and recycled sources is not provided in order to be consistent.

TABLE 2. CANADA, ZINC PRODUCTION AND EXPORTS,(1) 1975, 1980 AND 1986-2000

	Production		Exports		
	All Forms (2)	Refined (3)	In Ores and Concentrates	Refined	Total
			(tonnes)		
1975	1 055 151	426 902	705 088	247 474	952 562
1980	883 697	591 565	434 178	471 949	906 127
1986	988 173	570 981	450 249	427 176	877 425
1987	1 157 936	609 909	613 185	441 227	1 054 412
1988	1 370 000	703 206	816 885	551 521	1 368 406
1989	1 272 854	669 677	614 223	495 061	1 109 284
1990	1 179 372	591 786	716 185	452 251	1 168 436
1991	1 083 008	660 552	566 815	520 508	1 087 323
1992	1 195 736	671 702	678 172	509 744	1 187 916
1993	990 727	659 881	455 953	493 264	949 217
1994	976 309	690 965	450 320	551 168	1 001 488
1995	1 094 703	720 346	609 575	533 179	1 142 754
1996	1 162 720	716 467	(r) 670 789	581 604	(r) 1 252 393
1997	(r) 1 026 864	(r) 703 798	(r) 489 697	(r) 546 964	(r) 1 036 661
1998	991 584	745 131	425 341	576 926	1 002 267
1999	963 321	776 927	327 662	610 793	938 455
2000 (p)	935 686	787 527	311 490	602 588	914 078

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary; (r) Revised.
(1) Beginning in 1988, exports are based on the new Harmonized System and may not be in complete accordance with previous method of reporting. Ores and concentrates include HS classes 2608.00.30, 2603.00.30, 2607.00.30 and 2616.10.30. Refined production includes HS classes 7901.11 and 7901.12. (2) New refined zinc produced from domestic primary materials (concentrates, slags, residues, etc.) plus estimated recoverable zinc in ores and concentrates shipped for export. (3) Refined zinc produced from domestic and imported ores.

TABLE 3. WESTERN WORLD, PRIMARY ZINC STATISTICS, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 tonnes)		
Mine production (zinc content)	5 495	5 694	5 858	6 299	6 572
Metal production	5 582	5 713	5 832	6 130	6 241
Metal used	6 429	6 531	6 737	7 010	6 774

Source: International Lead and Zinc Study Group.
(p) Preliminary.

TABLE 4. WORLD MINE PRODUCTION OF ZINC, 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 tonnes)		
EUROPE					
Finland	32	31	20	16	20
Ireland	193	180	200	263	298
Poland	158	158	154	157	145
Russia	121	114	161	163	164
Spain	147	128	154	204	161
Sweden	155	161	175	177	159
Others	119	104	82	83	97
Subtotal	925	880	946	1 063	1 044
AFRICA					
Morocco	90	112	112	104	107
Namibia	37	42	35	40	38
South Africa	71	70	70	63	62
Others	10	33	51	48	48
Subtotal	208	257	268	255	255
OCEANIA					
Australia	972	1 020	1 110	1 379	1 476
AMERICAS					
Bolivia	154	151	145	149	149
Brazil	124	88	96	93	93
Canada	1 077	1 062	1 021	1002	1 052
Mexico	379	395	363	393	435
Peru	868	869	900	910	1 056
United States	632	755	813	837	798
Others	107	88	107	110	121
Subtotal	3 341	3 408	3 445	3 494	3 704
ASIA					
China	1 210	1 273	1 476	1 710	1 572
India	142	195	185	208	222
Iran	77	86	98	102	105
Japan	72	68	64	64	45
Kazakhstan	223	224	283	322	320
North Korea	60	44	37	34	28
Thailand	15	25	24	27	24
Turkey	64	58	57	48	36
Others	28	32	34	38	46
Subtotal	1 890	2 005	2 258	2 553	2 398
Total world	7 337	7 569	8 026	8 744	8 876
Total Western World	5 495	5 694	5 858	6 299	6 572

Source: International Lead and Zinc Study Group.

(p) Preliminary.

TABLE 5. WORLD ZINC METAL PRODUCTION,(1) 1997-2001

	1997	1998	1999	2000	2001 (p)
			(000 tonnes)		
EUROPE					
Belgium	203	205	232	264	256
Finland	176	199	225	223	249
France	317	320	318	318	329
Germany	348	361	361	357	357
Italy	268	232	145	170	179
Netherlands	203	217	221	217	206
Norway	136	138	144	138	145
Poland	171	175	179	179	175
Russia	189	197	232	242	250
Spain	378	385	383	391	443
Others	289	262	252	277	287
Subtotal	2 678	2 691	2 692	2 776	2 876
AFRICA					
Algeria	30	27	27	26	26
South Africa	110	108	108	103	109
Others	–	–	–	–	–
Subtotal	140	135	135	129	135
AMERICAS					
Argentina	39	39	40	36	40
Brazil	186	177	187	192	193
Canada	704	745	777	780	658
Mexico	230	229	219	233	300
Peru	173	184	191	200	190
United States	366	368	372	363	299
Subtotal	1 698	1 741	1 785	1 804	1 679
ASIA					
China	1 434	1 486	1 703	1 919	2 078
India	166	180	189	204	234
Japan	603	608	633	654	644
Kazakhstan	185	240	243	262	260
South Korea	335	390	430	477	508
Thailand	84	89	95	101	105
Others	152	150	119	119	132
Subtotal	2 959	3 143	3 412	3 736	3 961
OCEANIA					
Australia	307	311	344	494	556
Total world	7 783	8 021	8 369	8 939	9 207
Total Western World	5 583	5 713	5 832	6 130	6 241

Source: International Lead and Zinc Study Group.
– Nil; (p) Preliminary.

TABLE 6. ZINC USE,(1) BY COUNTRY AND BY REGION, 1997-2001

	1997	1998	1999	2000	2001 (p)
	(000 tonnes)				
EUROPE					
Belgium	260	260	275	285	265
France	271	285	298	310	329
Germany	530	573	561	532	549
Italy	354	373	336	385	365
Russia	146	111	120	137	150
Spain	160	197	190	203	228
United Kingdom	224	219	220	210	191
Others	628	632	610	653	658
Subtotal	2 573	2 650	2 610	2 715	2 735
AFRICA					
South Africa	98	91	87	92	89
Others	57	62	70	77	76
Subtotal	155	153	157	169	165
OCEANIA					
Australia	183	192	210	217	222
New Zealand	18	17	15	14	16
Subtotal	201	209	226	231	238
AMERICAS					
Brazil	190	177	187	188	198
Canada	161	170	169	176	181
Mexico	178	186	200	212	210
United States	1 243	1 307	1 342	1 340	1 147
Others	150	157	163	164	166
Subtotal	1 922	1 997	2 061	2 080	1 902
ASIA					
China	830	920	1 200	1 350	1 450
India	220	232	254	270	286
Japan	742	659	634	676	633
South Korea	343	318	389	438	381
Taiwan	225	241	273	294	276
Others	556	532	588	641	680
Subtotal	2 916	2 902	3 338	3 669	3 706
Total world	7 767	7 911	8 392	8 863	8 745
Total Western World	6 429	6 531	6 737	7 010	6 774

Source: International Lead and Zinc Study Group.

(p) Preliminary.

(1) Total refined zinc use, including zinc used directly for the production of zinc alloys, regardless of the type of source material from which it is produced, i.e., ores, concentrates, residues, slags or scrap. Remelted zinc and zinc dusts are excluded.

TABLE 7. CANADA, ZINC METAL CAPACITY, 2001

Company and Location	Annual Rated Capacity
	(000 tonnes of slab zinc)
PRIMARY	
Canadian Electrolytic Zinc Limited	
Valleyfield, Quebec	260
Falconbridge Limited	
Timmins, Ontario	145
Hudson Bay Mining and Smelting Co., Limited	
Flin Flon, Manitoba	115
Teck Cominco Ltd.	
Trail, British Columbia	290
Total primary, Canada	810

Source: Natural Resources Canada.

TABLE 8. MONTHLY AVERAGE ZINC PRICES, 2000 AND 2001

	LME Special High Grade Settlement
	(US$/t)
2000	
January	1 178.8
February	1 094.2
March	1 116.4
April	1 127.6
May	1 156.8
June	1 117.9
July	1 136.2
August	1 169.8
September	1 224.4
October	1 095.9
November	1 059.1
December	1 059.8
Yearly average	1 128.1
2001	
January	1 033.4
February	1 020.9
March	1 004.7
April	969.5
May	937.9
June	894.9
July	852.4
August	828.1
September	798.6
October	761.5
November	772.9
December	754.7
Yearly average	886.3

Source: International Lead and Zinc Study Group.

Statistical Report

This statistical summary of the Canadian mineral industry has been compiled by staff of the Minerals and Mining Statistics Division, Minerals and Metals Sector, Natural Resources Canada (NRCan), under the general direction of Yvan Gauthier, Director.

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Statistics contained in this summary are obtained from a variety of sources. Principal sources include the statistical survey programs of NRCan and Statistics Canada. The statistical survey program of the Minerals and Mining Statistics Division of NRCan is conducted jointly with the provincial/territorial governments and Statistics Canada in order to minimize the reporting burden on the mineral industry. The cooperation of the companies providing information is greatly appreciated.

*(**Note to Reader:** We continue to review the tables of this Report in order to establish the requirements of users. We would appreciate your feedback on which tables are important to you. Please contact Laurie Morrison at tel. (613) 992-6767 or e-mail lmorriso@nrcan.gc.ca to provide your input.)*

STATISTICAL TABLES

SECTION 1. PRODUCTION

1 Mineral Production of Canada, 1998-2001
2 Canada, Value of Mineral Production, Per Capita Value of Mineral Production, and Population, 1973-2001
3 Canada, Value of Mineral Production by Province, Territory and Mineral Class, 2001
4 Canada, Value of Mineral Production by Province and Territory, 1994-2001
5 Canada's World Role as a Producer of Certain Important Minerals, 2000
6 Canada, Gross Domestic Product of Industrial Production, Mining and Mineral Manufacturing at Factor Cost at 1997 Prices, 1997-2001
7 Canada, Gross Domestic Product by Industry at Basic Prices in 1997 Constant Dollars, 1997-2001

SECTION 2. TRADE

8 Canada, Stage I to Stage IV, Domestic Exports of Minerals and Mineral Products by Commodity, 1999-2001
9 Canada, Stage I to Stage IV, Imports of Minerals and Mineral Products by Commodity, 1999-2001
10 Canada, Stage I to Stage IV, Value of Minerals and Mineral Products, Exports by Commodity, by Destination, 2001
11 Canada, Stage I to Stage IV, Value of Minerals and Mineral Products, Imports by Commodity, by Origin, 2001

SECTION 3. USE

12 Canada, Apparent Use of Some Minerals and Relation to Production, 1998-2000
13 Canada, Reported Use of Minerals and Relation to Production, 1998-2000
14 Canada, Domestic Use of Principal Refined Metals in Relation to Refinery Production, 1994-2000

SECTION 4. PRICES

15 Average Annual Prices of Selected Metals, 1994-2001
16 Canadian Average Annual Prices of Selected Metals, 1994-2001

SECTION 5. PRINCIPAL STATISTICS

17 Canada, Principal Statistics of the Mineral Industry, 1999
18 Canada, Principal Statistics of the Mineral Manufacturing Industries, 1999
19 Canada, Principal Statistics of the Mineral Industry, 1989-99
20 Canada, Principal Statistics of the Mineral Manufacturing Industries, 1982-99
21 Canada, Consumption of Fuel and Electricity in the Non-Fuel Mineral Industry, 1999
22 Canada, Cost of Fuel and Electricity Used in the Non-Fuel Mineral Industry, 1995-99

SECTION 6. EMPLOYMENT, SALARIES AND WAGES

23 Canada, Employment in the Mineral Industry, Stage I – Mineral Extraction and Concentrating (Total Activity), 1961-2001
24 Canada, Non-Fuel Mineral Industry Employment by Stage, 1990-2001
25 Canada, Number of Wage Earners Employed in the Non-Fuel Mineral Industry (Surface, Underground and Mill), 1992-99
26 Canada, Mine and Mill Workers, by Sex, Employed in the Non-Fuel Mineral Industry, 1999
27 Canada, Labour Costs for Metal Mines in Relation to Tonnes Mined, 1997-99
28 Canada, Person-Hours Paid for Production and Related Workers, and Tonnes of Ore Mined and Rock Quarried in Metal Mines and Other Mineral Operations, 1994-99
29 Canada, Average Weekly Wages (Including Overtime) for Hourly Rated Employees in the Mining, Mineral Manufacturing, and Logging and Forestry Industries, 1993-2001
30 Canada, Number of Strikes and Lockouts by Industry, 1999-2001
31 Canada, Number of Strikes and Lockouts by Mining and Mineral Manufacturing Industry, 1999-2001
32 Canada, Mining Wages and Salaries by Province, Territory and Mineral Class, 1998 and 1999

SECTION 7. MINING AND EXPLORATION

33 Canada, Source of Ores Hoisted or Removed From Selected Types of Mines, 1997-99
34 Canada, Source of Material Hoisted or Removed From Selected Types of Mines, 1999
35 Canada, Ore Mined and Rock Quarried in the Mining Industry, 1995-99
36 Canada, Ore Mined and Rock Quarried in the Mining Industry, 1961-99

SECTION 8. TRANSPORTATION

37 Canada, Crude Minerals Transported by Canadian Railways, 1998-2001
38 Canada, Processed Mineral Products Transported by Canadian Railways, 1998-2001
39 Canada, Crude Minerals and Processed Mineral Products Transported by Canadian Railways, 1961-2001
40 Canada, Crude Minerals Loaded and Unloaded in Coastwise Shipping, 2000
41 Canada, Processed Mineral Products Loaded and Unloaded in Coastwise Shipping, 2000
42 Canada, Crude Minerals and Processed Mineral Products Loaded at Canadian Ports in Coastwise Shipping, 1961-2000

43 Canada, Crude Minerals Loaded and Unloaded at Canadian Ports in International Shipping Trade, 1998-2000
44 Canada, Processed Mineral Products Loaded and Unloaded at Canadian Ports in International Shipping Trade, 1998-2000
45 Canada, Crude Minerals and Processed Mineral Products Loaded at Canadian Ports in International Shipping Trade, 1961-2000

SECTION 9. INVESTMENT AND FINANCE

46 Canada, Capital and Repair Expenditures by Selected Industrial Sector, 2000-02
47 Canada, Capital and Repair Expenditures in the Mineral Industry by Province and Territory, 2000-02
48 Canada, Capital and Repair Expenditures in the Mining and Oil and Gas Extraction Industries, 2000-02

TABLE 1. MINERAL PRODUCTION OF CANADA, 1998-2001

	Unit	1998		1999		2000		2001	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS									
Antimony	kg	359	845	357	733	364	781	234	516
Bismuth	kg	186	2 078	217	2 402	202	2 343	258	3 163
Cadmium	kg	1 179	1 104	1 115	647	934	501	1 058	801
Calcium	kg	x	x	x	x	x	x	x	x
Cesium, pollucite	kg	x	x	x	x	x	x	x	x
Cobalt	kg	2 262	158 643	2 014	112 285	2 022	100 372	2 048	78 170
Columbium (niobium)	kg	2 194	x	2 313	x	2 183	x	2 850	x
Copper	kg	690 761	1 695 820	581 582	1 366 138	621 888	1 684 075	611 159	1 520 566
Germanium	kg	x	x	x	x	x	x	x	x
Gold	g	164 773	2 312 593	157 617	2 099 302	153 715	2 044 869	157 853	2 112 397
Ilmenite	t	x	x	x	x	x	x	x	x
Indium	g	x	x	x	x	x	x	x	x
Iron ore	t	36 586	1 646 419	33 789	1 303 667	35 247	1 424 448	26 981	1 155 187
Iron, remelt	t	x	x	x	x	x	x	x	x
Lead	kg	150 019	117 615	155 369	115 905	143 303	96 586	149 429	108 336
Lithium	kg	x	x	x	x	x	x	x	x
Magnesium	kg	x	x	x	x	x	x	x	x
Molybdenum	kg	8 099	98 752	6 250	59 558	6 980	62 736	8 540	77 054
Nickel	kg	197 947	1 411 167	176 749	1 591 805	181 136	2 323 827	183 643	1 763 340
Platinum group	g	14 033	214 883	13 872	250 466	15 304	478 460	18 154	568 758
Selenium	kg	398	2 960	359	2 677	335	4 053	261	3 122
Silver	kg	1 140	301 089	1 174	294 516	1 109	278 966	1 224	267 897
Tantalum	kg	70	9 863	66	9 304	70	10 030	94	13 616
Tellurium	kg	62	742	64	710	53	341	60	384
Uranium	kg	9 992	508 038	10 157	525 873	9 921	473 231	12 992	675 594
Zinc	kg	991 583	1 507 208	963 320	1 540 350	935 713	1 567 320	1 009 570	1 416 428
Total metals		..	10 429 061	..	9 703 890	..	10 980 027	..	10 245 404
NONMETALS									
Asbestos	t	321	167 386	337	161 000	310	141 670	294	132 200
Barite	t	86	9 142	67	6 900	21	4 659	24	4 934
Cement	t	12 124	1 147 757	12 625	1 230 972	12 612	1 258 697	12 986	1 312 450
Clay products		..	135 814	..	164 718	..	175 380	..	195 217
Diamonds	carats	203	40 775	2 429	606 254	2 435	624 949	3 685	846 925
Gemstones	kg	159	631	218	602	221	1 224	117	685
Graphite	t	x	x	x	x	x	x	x	x
Gypsum	t	8 307	94 349	9 345	106 634	8 572	105 655	8 119	96 436
Lime	t	2 461	214 966	2 565	238 893	2 525	237 601	2 221	212 435
Magnesitic dolomite	t	x	x	x	x	x	x	x	x
Marl	t	x	x	x	x	x	x	x	x
Mica	t	x	x	x	x	x	x	x	x
Nepheline syenite	t	636	53 405	676	57 400	717	62 376	734	64 439
Peat	t	1 125	166 542	1 253	181 903	1 277	173 958	1 187	167 889
Phosphates	t	–	–	x	x	x	x	x	x
Potash	t	8 884	1 747 965	8 475	1 634 041	9 033	1 644 196	8 184	1 581 526
Potassium sulphate	t	x	x	x	x	x	x	x	x
Pumice	t	x	x	x	x	x	x	x	x
Quartz	t	1 771	41 849	1 461	39 415	1 508	41 239	1 567	41 350
Salt	t	13 034	390 677	12 686	373 619	12 164	352 108	13 548	449 508
Sand and gravel	t	225 337	875 226	243 251	960 785	238 901	971 159	225 991	953 181
Serpentine	t	x	x	x	x	x	x	x	x
Soapstone, talc and pyrophyllite	t	72	15 545	79	21 108	85	25 476	55	16 645
Sodium sulphate	t	258	27 080	x	x	x	x	x	x
Stone	t	108 924	727 947	109 184	775 499	118 335	882 343	119 805	884 081
Sulphur in smelter gas	t	836	55 451	843	57 851	831	56 643	832	35 498
Sulphur, elemental	t	8 404	62 109	8 656	96 969	8 621	92 411	8 080	1 171
Titanium dioxide	t	x	x	x	x	x	x	x	x
Tremolite	t	x	x	x	x	x	x	x	x
Wollastonite	t	x	x	x	x	x	x	x	x
Zeolite	t	x	x	x	x	x	x	x	x
Total nonmetals		..	6 527 184	..	7 332 909	..	7 427 529	..	7 552 306
MINERAL FUELS									
Coal	t	75 360	1 764 770	72 497	1 474 495	69 163	1 427 366	70 361	1 546 798
Natural gas	000 m^3	160 514	10 893 493	162 218	14 192 201	167 790	27 827 727	171 966	33 814 851
Natural gas by-products	m^3	26 665	1 763 072	28 805	2 534 713	30 543	5 660 657	29 789	4 681 739
Petroleum	m^3	128 401	12 940 149	122 247	18 698 282	127 809	30 523 595	130 526	25 941 288
Total fuels		..	27 361 484	..	36 899 691	..	65 439 345	..	65 984 676
Total all minerals		..	44 317 729	..	53 936 491	..	83 846 901	..	83 782 386

Sources: Natural Resources Canada; Statistics Canada.

– Nil; . . Not available; (p) Preliminary; x Confidential.

Notes: Numbers may not add to totals due to rounding. Confidential values are included in totals.

TABLE 2. CANADA, VALUE OF MINERAL PRODUCTION, PER CAPITA VALUE OF MINERAL PRODUCTION, AND POPULATION, 1973-2001

	Value of Mineral Production					
Year	Metals	Nonmetals (including structural materials)	Fuels	Total	Per Capita Value of Mineral Production	Population of Canada
		($ millions)			($)	(000)
1973	3 947	1 293	3 227	8 467	375.31	22 560
1974	4 934	1 731	5 202	11 867	518.78	22 875
1975	5 022	1 898	6 653	13 574	584.86	23 209
1976	5 344	2 273	8 109	15 726	668.68	23 518
1977	6 031	2 612	9 873	18 516	778.11	23 796
1978	5 746	2 989	11 578	20 313	845.11	24 036
1979	8 006	3 516	15 117	26 636	1 097.25	24 277
1980	9 777	4 155	17 944	31 875	1 296.10	24 593
1981	8 841	4 491	19 046	32 378	1 300.32	24 900
1982	6 953	3 841	23 038	33 831	1 342.39	25 202
1983	7 528	3 857	27 154	38 539	1 513.95	25 456
1984	8 897	4 493	30 399	43 789	1 703.72	25 702
1985	8 745	4 864	31 120	44 730	1 724.23	25 942
1986	8 819	4 864	18 763	32 446	1 238.21	26 204
1987	10 962	5 125	20 274	36 361	1 369.53	26 550
1988	13 608	5 574	17 773	36 955	1 374.05	26 895
1989	13 982	5 566	19 785	39 333	1 436.61	27 379
1990	12 500	5 289	22 990	40 778	1 467.31	27 791
1991	10 462	4 783	19 945	35 190	1 251.42	28 120
1992	10 210	4 473	20 901	35 584	1 246.72	28 542
1993	8 871	4 459	23 214	36 545	1 262.48	28 947
1994	9 750	5 192	26 243	41 185	1 418.41	29 036
1995	12 173	5 436	25 759	43 367	1 477.38	29 354
1996	11 697	5 408	32 581	49 687	1 674.54	29 672
1997	11 549	5 912	33 077	50 538	1 685.33	29 987
1998	10 429	6 527	27 361	44 318	1 465.20	30 247
1999	9 704	7 333	36 900	53 936	1 768.92	30 491
2000	10 980	7 428	65 439	83 847	2 726.73	30 750
2001 (p)	10 245	7 552	65 985	83 782	2 695.52	31 082

Sources: Natural Resources Canada; Statistics Canada.
(p) Preliminary.
Notes: Beginning in 1986, bentonite, diatomite and sodium antimonate are reported in industrial minerals.
Numbers may not add to totals due to rounding.

TABLE 3. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE, TERRITORY AND MINERAL CLASS, 2001 (p)

Province/Territory	Metals		Nonmetals		Mineral Fuels		Total	
	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)	($000)	(% of total)
Newfoundland and Labrador	788 835	7.7	42 918	0.6	1 971 355	3.0	2 803 108	3.3
Prince Edward Island	–	–	4 586	0.1	–	–	4 586	. . .
Nova Scotia	–	–	238 730	3.2	1 176 444	1.8	1 415 174	1.7
New Brunswick	562 326	5.5	207 090	2.7	19 781	0.0	789 197	0.9
Quebec	2 157 584	21.1	1 332 617	17.6	–	–	3 490 201	4.2
Ontario	3 388 065	33.1	2 116 194	28.0	130 485	0.2	5 634 744	6.7
Manitoba	823 884	8.0	78 137	1.0	145 661	0.2	1 047 682	1.3
Saskatchewan	699 532	6.8	1 601 718	21.2	5 674 605	8.6	7 975 855	9.5
Alberta	258	. . .	559 791	7.4	49 272 437	74.7	49 832 486	59.5
British Columbia	1 411 796	13.8	515 800	6.8	7 101 196	10.8	9 028 792	10.8
Yukon	39 698	0.4	3 428	. . .	54 535	0.1	97 661	0.1
Northwest Territories	54 208	0.5	851 297	11.3	438 177	0.7	1 343 682	1.6
Nunavut	319 217	3.1	–	–	–	–	319 217	0.4
Total	10 245 404	100.0	7 552 306	100.0	65 984 676	100.0	83 782 386	100.0

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed; (p) Preliminary.
Note: Numbers may not add to totals due to rounding.

TABLE 4. CANADA, VALUE OF MINERAL PRODUCTION BY PROVINCE AND TERRITORY, 1994-2001

Province/Territory	1994	1995	1996	1997	1998	1999 (r)	2000	2001 (p)
				($ millions)				
Alberta	21 119	20 676	26 218	26 671	21 886	29 230	49 967	49 832
Saskatchewan	4 225	4 580	5 331	5 508	4 796	5 997	8 415	7 976
British Columbia	4 066	4 501	4 340	4 681	4 466	4 538	7 901	9 029
Ontario	4 921	5 825	5 718	5 615	5 044	5 222	5 867	5 634
Quebec	2 956	3 338	3 415	3 437	3 560	3 657	3 653	3 490
Newfoundland and Labrador	837	878	906	1 038	1 539	1 818	3 170	2 803
Manitoba	820	1 022	1 002	1 126	967	907	1 234	1 048
Nova Scotia	608	560	593	481	453	380	1 193	1 415
Northwest Territories	680	766	781	799	585	893	1 165	1 344
New Brunswick	862	1 021	955	953	863	851	773	789
Nunavut	n.a.	n.a.	n.a.	n.a.	n.a.	349	385	319
Yukon	86	196	426	225	150	89	118	98
Prince Edward Island	3	4	4	3	6	7	5	5
Total	41 185	43 367	49 687	50 538	44 318	53 936	83 847	83 782

Sources: Natural Resources Canada; Statistics Canada.
n.a. Not applicable; (p) Preliminary; (r) Revised.
Note: Numbers may not add to totals due to rounding.

TABLE 5. CANADA'S WORLD ROLE AS A PRODUCER OF CERTAIN IMPORTANT MINERALS, 2000 $^{(p)}$

		World	Rank of Five Leading Countries				
			1	2	3	4	5
			Canada	C.I.S.	Germany	Israel	United States
Potash (K_2O equivalent)	000 t	26 580	**9 409**	7 098	3 409	1 748	1 350
(mine production)	% of world total		**35.4**	26.7	12.8	6.6	5.1
			Canada	Australia	Niger	Namibia	Uzbekistan
Uranium (U concentrates)	t	34 802	(a) **10 680**	7 588	2 898	2 713	2 350
(mine production)	% of world total		**30.7**	21.8	8.3	7.8	6.8
			C.I.S.	**Canada**	China	Brazil	Zimbabwe
Asbestos (mine production)	000 t	1 885	700	**320**	300	170	130
	% of world total		37.1	**17**	15.9	9	6.9
			Russia	**Canada**	Australia	New Caledonia	Indonesia
Nickel (mine production)	000 t	1 196	235	**191**	168	128	98
	% of world total		19.6	**15.9**	14.1	10.7	8.2
			Australia	South Africa	**Canada**	Norway	Ukraine
Titanium concentrate	000 t	7 257	2 420	1 220	**950**	610	577
	% of world total		33.3	16.8	**13.1**	8.4	7.9
			China	Australia	**Canada**	Peru	United States
Zinc (mine production)	000 t	8 718	1 710	1 410	**997**	910	829
	% of world total		19.6	16.2	**11.4**	10.4	9.5
			Japan	China	**Canada**	South Korea	United States
Cadmium (refined production)	t	19 759	2 472	2 200	**2 024**	1 911	1 890
	% of world total		12.5	11.1	**10.2**	9.7	9.6
			United States	Iran	**Canada**	China	Spain
Gypsum (mine production)	000 t	109 156	25 000	9 750	**9 006**	9 000	7 500
	% of world total		22.9	8.9	**8.3**	8.2	6.9
			South Africa	Russia	**Canada**	United States	Japan
Platinum group metals	kg	365 687	201 844	128 100	**15 439**	13 410	5 494
(mine production)	% of world total		55.2	35	**4.2**	3.7	1.5
			Zambia	Russia	Brazil	**Canada**	Cuba
Cobalt (shipments)	t	33 383	7 000	4 500	4 100	**4 091**	3 095
	% of world total		21	13.5	12.3	**12.3**	9.3
			United States	Russia	China	**Canada**	Australia
Aluminum (primary metal)	000 t	24 624	3 668	3 247	2 989	**2 374**	1 762
	% of world total		14.9	13.2	12.1	**9.6**	7.2
			United States	Chile	China	**Canada**	Peru
Molybdenum (Mo content)	t	129 873	41 100	29 100	28 900	**7 458**	7 193
(mine production)	% of world total		31.6	22.4	22.3	**5.7**	5.5
			South Africa	United States	Australia	China	**Canada**
Gold (mine production)	t	2 559	431	353	297	176	**156**
	% of world total		16.8	13.8	11.6	7	**6.1**
			United States	China	Germany	India	**Canada**
Salt (mine production)	000 t	209 554	45 300	30 000	15 800	14 500	**12 054**
	% of world total		21.6	14.3	7.5	6.9	**5.8**
			Australia	China	United States	Peru	**Canada**
Lead (mine production)	000 t	3 008	678	570	468	271	**149**
	% of world total		22.5	18.9	15.6	9	**4.9**
			Chile	United States	Indonesia	Australia	**Canada**
Copper (mine production)	000 t	13 191	4 602	1 443	1 005	829	**634**
	% of world total		34.9	10.9	7.6	6.3	**4.8**

Sources: Natural Resources Canada, from *World Nonferrous Metal Statistics* and the *Canadian Minerals Yearbook* ; U.S. Geological Survey.
C.I.S. Commonwealth of Independent States; (p) Preliminary.
(a) Includes uranium (tU) recovered by Elliot Lake producers from refinery/conversion facility wastes.

TABLE 6. CANADA, GROSS DOMESTIC PRODUCT OF INDUSTRIAL PRODUCTION, MINING AND MINERAL MANUFACTURING AT BASIC PRICES IN 1997 CONSTANT DOLLARS, 1997-2001

	1997	1998	1999	2000	2001
			($ millions)		
Total industrial production (1)	202 902	209 820	221 560	233 830	226 984
Total mining and oil and gas extraction (2)	33 935	34 200	33 453	36 125	36 703
METALS					
Iron ore mining	647	621	523	608	485
Gold and silver ore mining	1 301	1 420	1 387	1 393	1 434
Copper, nickel, lead and zinc mining	2 662	2 796	2 539	2 548	2 612
Other metal ore mining	417	386	289	372	437
MINERAL FUELS					
Oil and gas extraction	21 203	21 822	21 536	22 433	22 661
NONMETALS					
Miscellaneous nonmetals (including asbestos) mining	362	373	638	617	707
Potash mining	1 038	956	867	957	845
Salt mining	243	219	204	195	231
Coal mining	1 209	1 180	1 138	1 078	1 117
Quarries and sand pits	821	841	870	919	892
SUPPORT ACTIVITIES FOR MINING AND OIL AND GAS EXTRACTION	4 032	3 586	3 462	5 005	5 282
MINERAL MANUFACTURING					
Primary metals	9 586	10 433	10 632	10 798	10 599
Iron and steel mills and ferro-alloys	3 142	3 465	3 630	3 615	3 421
Steel product manufacturing (from purchased steel)	1 192	1 140	1 172	1 240	1 170
Alumina and aluminum	2 088	2 451	2 492	2 475	2 644
Nonferrous metals (except aluminum)	1 865	2 058	2 035	2 127	2 108
Foundries	1 299	1 319	1 303	1 341	1 256
Nonmetallic mineral products	3 789	4 158	4 530	4 606	4 622
Clay products and refractory manufacturing	282	271	297	282	254
Glass and glass products manufacturing	838	1 108	1 259	1 386	1 355
Cement and concrete products manufacturing	1 774	1 815	1 912	1 973	2 017
Ready-mix concrete manufacturing	572	585	582	588	615
Lime and gypsum products manufacturing	407	419	441	357	406
Other nonmetallic mineral products manufacturing	488	545	621	608	590
Fabricated metal products	9 327	9 885	10 569	11 230	11 073
Petroleum and coal products	1 657	1 763	1 877	1 868	1 941

Sources: Natural Resources Canada; Statistics Canada.

(1) Includes mining and oil and gas extraction, mineral manufacturing and utilities. (2) Includes metal mining, nonmetal mining (including coal mining), quarries and sand pits, crude petroleum and natural gas, and support activities.

TABLE 7. CANADA, GROSS DOMESTIC PRODUCT BY INDUSTRY AT BASIC PRICES IN 1997 CONSTANT DOLLARS, 1997-2001

	1997	1998	1999	2000	2001
			($ millions)		
Gross domestic product, all industries	816 906	848 364	889 367	929 556	939 901
Agriculture	12 767	13 884	14 545	14 174	12 899
Fishing, hunting and trapping	847	842	848	848	925
Forestry and logging	5 564	5 549	6 226	6 454	6 139
Support activities for agriculture and forestry	1 249	1 376	1 407	1 386	1 353
Mining and oil and gas extraction	33 935	34 200	33 453	36 125	36 703
Manufacturing	142 282	149 625	161 130	169 471	162 713
Construction	42 995	43 974	46 384	48 534	50 238
Transportation and warehousing	40 337	41 009	42 738	44 658	43 394
Information and culture	27 979	30 228	34 845	39 760	43 770
Electric power, gas and water utilities	26 685	25 995	26 977	28 234	27 568
Trade, wholesale	43 723	46 973	52 699	55 659	56 131
Trade, retail	42 281	45 231	47 475	49 820	51 334
Finance, insurance and real estate	161 137	166 469	171 724	177 925	183 902
Community, business and personal services	185 643	193 505	198 520	205 499	209 959
Public administration	49 482	49 504	50 396	51 009	52 873

Source: Statistics Canada.

TABLE 8. CANADA, STAGE I TO IV, DOMESTIC EXPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 1999-2001

	Unit of Measure	1999		2000		2001 (p)	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS							
Aluminum	..	..	7 196 292	..	8 002 634	..	8 213 288
Antimony	kg	58	491	62	447	90	505
Bismuth	kg	188	2 102	281	3 038	98	1 070
Cadmium	kg	2 231	3 789	2 172	4 170	1 478	5 052
Calcium metal	kg	1 975	2 650	1 355	2 612	732	1 563
Chromium	kg	6 478	29 914	6 715	30 056	6 777	29 403
Cobalt	kg	6 545	295 527	5 322	237 628	5 364	196 437
Copper	..	..	2 068 636	..	2 604 826	..	2 522 439
Gold	..	..	2 811 460	..	2 588 960	..	2 281 056
Iron and steel	..	..	9 813 372	..	11 045 183	..	10 349 324
Iron ore	t	26 477	1 052 194	26 388	1 056 226	21 981	942 909
Lead	..	..	280 242	..	277 662	..	238 786
Magnesium and magnesium compounds	kg	118 088	251 656	123 286	232 763	111 770	200 727
Molybdenum	kg	10 688	47 480	10 681	48 704	13 447	56 243
Nickel	..	..	1 697 634	..	2 537 863	..	2 249 076
Platinum group metals	..	..	204 003	..	344 690	..	354 532
Silver	..	..	488 117	..	466 761	..	449 779
Tin	..	..	11 818	..	11 837	..	9 250
Titanium metal	kg	34 140	39 664	90 037	16 880	57 015	23 407
Uranium and thorium	..	..	719 140	..	622 537	..	920 852
Zinc	kg	1 029 258	1 587 855	1 041 821	1 670 417	1 069 698	1 307 652
Other metals	..	..	4 986 188	..	6 384 736	..	5 730 814
Total metals	..	..	33 590 224	..	38 190 630	..	36 084 164
NONMETALS							
Asbestos	..	..	271 021	..	261 061	..	246 829
Barite and witherite	t	16	6 061	11	3 995	8	3 147
Cement	..	..	735 696	..	746 752	..	811 323
Clay and clay products	..	..	45 577	..	51 457	..	46 170
Diamonds	..	..	559 734	..	672 336	..	722 762
Graphite	..	..	106 060	..	84 431	..	55 977
Gypsum	..	..	461 821	..	286 578	..	269 837
Lime	kg	96 058	13 214	80 630	11 436	93 516	15 321
Mica	t	24	14 214	25	14 651	20	12 514
Nepheline syenite	t	331	48 959	377	52 130	358	51 378
Peat	..	..	331 380	..	330 141	..	318 143
Potash and potassium compounds	kg	14 361 803	2 109 106	15 140 910	2 428 565	13 600 424	2 221 384
Salt and sodium compounds	t	4 862	492 253	4 576	491 775	5 773	639 396
Sand and gravel	t	2 874	25 713	3 185	29 902	4 121	41 452
Silica and silica compounds	..	..	22 179	..	22 519	..	28 671
Stones	..	3 121	154 268	3 487	185 047	3 221	141 559
Sulphur and sulphur compounds	t	6 050	322 093	5 796	335 606	3 990	221 636
Talc, soapstone and pyrophyllite	t	44	17 723	59	22 885	46	20 053
Titanium oxides	kg	82 287	212 456	70 587	187 044	63 539	175 012
Other nonmetals	..	..	3 103 959	..	3 981 778	..	4 053 345
Total nonmetals	..	..	9 053 487	..	9 453 337	..	9 284 586
FUELS							
Coal and coke	t	34 270	2 044 336	32 771	1 872 673	29 863	1 985 087
Natural gas	000m^3	95 121	10 951 393	101 145	20 555 588	108 729	25 510 285
Natural gas by-products	000m^3	8	977 309	12	1 816 085	9	2 022 119
Petroleum	..	..	14 993 573	..	27 571 416	..	24 977 546
Other fuels	kg	170 991	251 246	209 086	300 526	226 926	309 368
Total fuels	..	..	29 217 857	..	52 116 288	..	54 804 405
Total mining domestic exports (Including fuels)	..	..	71 861 568	..	99 760 255	..	100 173 155
Total economy domestic exports	..	..	331 346 517	..	385 330 559	..	373 447 193

Sources: Natural Resources Canada; Statistics Canada.
. . Not available or not applicable; (p) Preliminary
Note: Totals may not add due to rounding.

TABLE 9. CANADA, STAGE I TO STAGE IV, IMPORTS OF MINERALS AND MINERAL PRODUCTS BY COMMODITY, 1999-2001

	Unit of Measure	1999		2000		2001 (p)	
	(000)	(quantity)	($000)	(quantity)	($000)	(quantity)	($000)
METALS							
Aluminum	. .	. .	4 448 112	. .	5 009 047	. .	4 866 712
Antimony	kg	2 625	8 462	2 654	8 497	2 332	7 240
Bismuth	kg	182	1 564	424	2 640	319	2 399
Cadmium	kg	62	836	75	1 217	56	1 051
Calcium metal	kg	101 566	48 476	122 691	51 652	85 442	45 679
Chromium	kg	98 994	80 908	69 900	79 201	60 989	69 721
Cobalt	kg	1 190	37 561	1 540	49 331	1 906	41 284
Copper	. .	. .	1 663 186	. .	3 350 352	. .	1 827 701
Gold	. .	. .	1 059 400	. .	954 657	. .	808 183
Iron and steel	. .	. .	15 455 237	. .	17 131 354	. .	15 058 254
Iron ore	t	6 950	355 665	6 618	364 182	5 961	340 313
Lead	. .	. .	392 657	. .	468 186	. .	382 435
Magnesium and magnesium compounds	kg	200 131	211 588	240 155	192 772	177 991	176 557
Molybdenum	kg	5 040	39 405	5 030	38 494	3 973	33 084
Nickel	. .	. .	294 682	. .	396 371	. .	349 996
Platinum group metals	g	1 549 407	181 782	2 106 669	378 022	2 264 344	415 968
Silver	. .	. .	134 301	. .	150 552	. .	154 167
Tin	. .	. .	73 301	. .	70 891	. .	55 828
Titanium metal	kg	7 876	68 302	11 745	151 819	12 013	107 704
Uranium and thorium	. .	. .	295 282	. .	252 757	. .	243 147
Zinc	. .	. .	262 339	. .	269 191	. .	198 274
Other metals	. .	. .	11 142 854	. .	12 356 157	. .	11 939 723
Total metals	. .	. .	36 255 900	. .	41 727 342	. .	37 125 420
NONMETALS							
Asbestos	. .	. .	102 952	. .	103 143	. .	93 968
Barite and witherite	t	56	7 164	58	6 679	80	9 290
Cement	. .	. .	210 954	. .	233 623	. .	242 217
Clay and clay products	. .	. .	893 012	. .	977 008	. .	998 869
Diamonds	. .	. .	295 821	. .	342 587	. .	298 868
Graphite	. .	. .	506 366	. .	472 395	. .	413 874
Gypsum	. .	. .	48 199	. .	48 258	. .	61 576
Lime	kg	54 535	7 723	62 296	8 067	94 319	11 866
Mica	t	5	13 169	7	12 790	7	13 604
Nepheline syenite	t	. . .	13	. . .	2	. . .	6
Peat	. .	. .	1 814	. .	1 219	. .	1 735
Potash and potassium compounds	kg	106 865	37 353	130 741	38 753	122 083	41 548
Salt and sodium compounds	t	2 394	318 425	2 270	348 261	3 040	405 662
Sand and gravel	t	3 078	18 187	2 956	17 679	2 414	14 878
Silica and silica compounds	. .	. .	196 131	. .	217 301	. .	202 168
Stones	. .	4 304	135 401	4 373	138 690	5 199	173 453
Sulphur and sulphur compounds	t	196	21 213	221	24 184	227	25 608
Talc, soapstone and pyrophyllite	t	58	14 533	62	15 497	69	17 858
Titanium oxides	kg	111 962	276 440	98 603	261 903	89 187	237 919
Other nonmetals	. .	. .	4 403 218	. .	5 009 467	. .	4 901 162
Total nonmetals	. .	. .	7 508 088	. .	8 277 506	. .	8 166 129
FUELS							
Coal and coke	t	20 933	1 116 475	20 786	1 171 592	20 831	1 262 995
Natural gas	$000m^3$	630	87 885	1 201	228 763	1 283	386 186
Natural gas by-products	$000m^3$	. . .	71 309	1	146 207	. . .	91 471
Petroleum	. .	. .	9 777 862	. .	17 306 251	. .	16 595 355
Other fuels	. .	. .	509 103	. .	530 410	. .	578 850
Total fuels	. .	. .	11 562 634	. .	19 383 223	. .	18 914 857
Total mining imports (including fuels)			55 326 622		69 388 071		64 206 406
Total economy imports			320 260 998		356 717 542		343 002 846

Sources: Natural Resources Canada; Statistics Canada.

. . Not available or not applicable; . . . Amount too small to be expressed; (p) Preliminary.

Note: Numbers may not add to totals due to rounding.

TABLE 10. CANADA, STAGE I TO STAGE IV, VALUE OF MINERALS AND MINERAL PRODUCTS, EXPORTS BY COMMODITY, BY DESTINATION, 2001

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	7 286 047	412 123	267 931	26 706	220 481	8 213 288
Antimony	468	21	–	–	16	505
Bismuth	447	436	158	–	29	1 070
Cadmium	3 270	739	346	–	697	5 052
Calcium metal	399	841	78	–	245	1 563
Chromium	29 191	–	175	–	37	29 403
Cobalt	38 656	61 061	31 922	56	64 742	196 437
Copper	1 854 110	116 340	279 808	9 841	262 340	2 522 439
Gold	2 028 156	176 792	20 378	10 828	44 902	2 281 056
Iron and steel	9 809 337	152 670	14 741	94 747	277 829	10 349 324
Iron ore	206 602	487 510	25 790	–	223 007	942 909
Lead	190 458	36 258	166	896	11 008	238 786
Magnesium and magnesium compounds	145 593	40 249	4 414	195	10 276	200 727
Molybdenum	15 981	13 109	16 707	–	10 446	56 243
Nickel	654 183	613 439	31 091	73	950 290	2 249 076
Platinum group metals	143 331	211 181	–	. . .	20	354 532
Silver	379 977	38 931	26 538	–	4 333	449 779
Tin	8 436	627	59	–	128	9 250
Titanium metal	19 461	2 503	–	–	1 443	23 407
Uranium and thorium	521 857	212 973	754	1 146	184 122	920 852
Zinc	865 351	298 660	19 757	134	123 750	1 307 652
Other metals	4 924 254	404 311	160 299	18 639	223 311	5 730 814
Total metals	29 125 565	3 280 774	901 112	163 261	2 613 452	36 084 164
NONMETALS						
Asbestos	93 559	10 708	28 877	7 400	106 285	246 829
Barite and witherite	2 954	97	–	–	96	3 147
Cement	725 380	2 861	2 171	–	5 284	735 696
Clay and clay products	33 917	7 659	256	2	4 336	46 170
Diamonds	26 636	695 875	21	–	230	722 762
Graphite	47 841	3 028	23	–	5 085	55 977
Gypsum	268 181	331	141	–	1 184	269 837
Lime	15 305	1	–	–	15	15 321
Mica	10 133	616	1 384	1	380	12 514
Nepheline syenite	43 903	1 916	1 109	79	4 371	51 378
Peat	289 212	1 488	18 138	108	9 197	318 143
Potash and potassium compounds	1 064 161	39 416	118 347	1 787	997 673	2 221 384
Salt and sodium compounds	589 729	9	11 653	–	38 005	639 396
Sand and gravel	40 683	11	–	–	758	41 452
Silica and silica compounds	25 167	228	4	. . .	3 272	28 671
Stones	125 441	6 388	3 538	531	5 661	141 559
Sulphur and sulphur compounds	52 928	101	–	7 309	161 298	221 636
Talc, soapstone and pyrophyllite	19 887	35	105	–	26	20 053
Titanium oxides	168 710	3 346	–	–	2 956	175 012
Other nonmetals	3 100 225	85 218	9 572	16 094	106 540	3 317 649
Total nonmetals	6 743 952	859 332	195 339	33 311	1 452 652	9 284 586
FUELS						
Coal and coke	331 577	412 584	629 013	26 393	585 520	1 985 087
Natural gas	25 510 272	13	–	–	–	25 510 285
Natural gas by-products	2 022 026	–	–	–	93	2 022 119
Petroleum	24 649 076	246 462	31 555	561	49 892	24 977 546
Other fuels	269 241	16 654	5 320	215	17 938	309 368
Total fuels	52 782 192	675 713	665 888	27 169	653 443	54 804 405
Total mining domestic exports	88 651 709	4 815 819	1 762 339	223 741	4 719 547	100 173 155

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed.
Note: Numbers may not add to totals due to rounding.

TABLE 11. CANADA, STAGE I TO STAGE IV, VALUE OF MINERALS AND MINERAL PRODUCTS, IMPORTS BY COMMODITY, BY ORIGIN, 2001

	United States	EU	Japan	Mexico	Other	Total
			($000)			
METALS						
Aluminum	3 494 797	246 148	21 166	13 831	1 091 391	4 867 333
Antimony	5 416	552	49	391	833	7 241
Bismuth	1 438	322	–	17	622	2 399
Cadmium	593	413	. . .	7	38	1 051
Calcium metal	36 107	4 129	113	. . .	641	40 990
Chromium	20 496	6 435	1 668	1 541	39 564	69 704
Cobalt	14 615	11 182	797	–	14 690	41 284
Copper	1 084 115	188 632	6 685	27 542	520 729	1 827 703
Gold	379 382	36 088	14	1 457	391 039	807 980
Iron and steel	10 795 613	1 439 799	509 580	399 024	1 916 681	15 060 697
Iron ore	338 062	2 016	–	–	235	340 313
Lead	270 350	22 494	14 517	7 654	67 774	382 789
Magnesium and magnesium compounds	95 802	8 980	1 103	224	70 449	176 558
Molybdenum	23 211	3 391	41	1 619	4 822	33 084
Nickel	161 100	49 764	45 426	6 658	87 023	349 971
Platinum group metals	268 270	93 576	1 719	. . .	52 402	415 967
Silver	75 785	16 925	917	12 394	47 955	153 986
Tin	27 519	2 323	24	415	25 545	55 826
Titanium metal	79 422	14 452	4 283	–	9 535	107 692
Uranium and thorium	57 571	21 265	42	–	164 266	243 144
Zinc	124 921	14 776	56	20 846	37 651	198 250
Other metals	7 978 590	913 735	247 029	860 221	1 941 884	11 941 459
Total metals	25 333 185	3 097 397	855 229	1 353 841	6 485 769	37 125 420
NONMETALS						
Asbestos	69 931	3 429	4 975	2 976	12 682	93 993
Barite and witherite	5 220	258	3	–	3 809	9 290
Cement	203 146	10 253	547	2 705	25 565	242 216
Clay and clay products	416 606	242 466	25 446	44 845	269 078	998 441
Diamonds	49 965	80 598	87	–	168 239	298 889
Graphite	329 825	32 434	36 573	1 067	28 353	428 252
Gypsum	54 952	744	171	4 197	1 512	61 576
Lime	11 820	12	. . .	–	34	11 866
Mica	9 892	2 198	358	–	1 156	13 604
Nepheline syenite	. . .	–	–	–	6	6
Peat	334	266	–	–	1 133	1 733
Potash and potassium compounds	36 164	3 297	55	2	2 030	41 548
Salt and sodium compounds	346 415	14 490	3 339	5 897	35 466	405 607
Sand and gravel	14 428	106	. . .	5	547	15 086
Silica and silica compounds	166 469	14 872	6 195	4 279	10 295	202 110
Stone	63 617	54 391	25	2 889	52 481	173 403
Sulphur and sulphur compounds	24 230	1 268	6	. . .	96	25 600
Talc, soapstone and pyrophyllite	16 337	94	393	–	964	17 788
Titanium oxides	175 203	43 640	1 194	1	17 968	238 006
Other nonmetals	3 770 366	473 115	71 343	112 805	459 487	4 887 116
Total nonmetals	5 764 920	977 931	150 710	181 668	1 090 901	8 166 129
FUELS						
Coal and coke	1 057 928	3 334	1 693	1 196	198 825	1 262 976
Natural gas	291 713	16	5	–	2 922	294 656
Natural gas by-products	86 784	2 061	. . .	–	2 636	91 481
Petroleum	2 886 696	5 235 497	16 768	431 031	8 117 053	16 687 045
Other fuels	528 513	38 065	3 615	458	8 048	578 699
Total fuels	4 851 634	5 278 973	22 081	432 685	8 329 484	18 914 857
Total mining imports	35 949 739	9 354 301	1 028 021	1 968 194	15 906 154	64 206 406

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . . Amount too small to be expressed.
Note: Numbers may not add to totals due to rounding.

TABLE 12. CANADA, APPARENT USE(1) OF SOME MINERALS AND RELATION TO PRODUCTION,(2) 1998-2000

	1998			1999			2000		
	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production	Apparent Use	Production	Use as a Percentage of Production
	(tonnes)			(tonnes)			(tonnes)		
Quartz silica	(r) 2 112 673	1 885 926	112.0	(r) 1 686 489	1 564 186	107.8	1 615 699	1 617 955	99.9
Lime (3)	2 323 628	2 461 043	94.4	(r) 2 523 928	2 565 451	(r) 98.4	2 506 984	2 525 369	99.3
Salt	(r) 9 834 358	13 034 295	75.4	(r) 10 253 435	12 685 895	(r) 80.8	9 829 983	12 164 069	80.8
Cement (4)	6 952 314	12 124 058	57.3	(r) 7 954 459	(r) 12 624 924	(r) 62.9	8 706 808	12 611 954	69.1
Iron ore	13 517 652	36 585 595	36.9	(r) 14 215 653	(r) 35 788 656	(r) 42.1	15 424 572	35 246 892	43.8
Gypsum	(r) 2 850 979	8 306 534	34.3	3 241 560	9 345 342	34.7	2 408 382	8 572 464	28.1
Potash						..			..
(K_2O equivalent)	202 130	8 883 616	2.3	–	8 475 270		–	9 033 330	
Asbestos	2 039	321 330	0.6	5 165	337 367	1.5	–	309 719	..

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; K_2O Potassium oxide; (r) Revised.

(1) "Apparent use" is production plus imports, less exports. (2) "Production" refers to producers' shipments. (3) "Apparent Use" contains slaked lime in the trade data. (4) "Apparent Use" contains clinker cement in the trade data.

TABLE 13. CANADA, REPORTED USE OF MINERALS AND RELATION TO PRODUCTION, 1998-2000

		1998			1999			2000		
	Unit of Measure	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production	Use	Production	Use as a Percentage of Production
		(tonnes)			(tonnes)			(tonnes)		
METALS										
Aluminum (1)	t	889 973	2 374 118	37.5	999 242	2 389 834	41.8	1 015 640	2 373 460	42.8
Antimony	kg	791 255	359 347	220.2	865 383	356 745	242.6	777 505	364 100	213.5
Bismuth	kg	14 641	186 400	7.9	17 066	217 135	7.9	12 553	202 228	6.2
Cadmium	kg	117 122	1 179 427	9.9	138 789	1 114 921	12.4	172 304	934 084	18.4
Chromium (chromite)	t	16 964	–	..	x	–	x	x	–	x
Cobalt	kg	145 983	2 262 477	6.5	129 988	2 013 897	6.5	126 715	2 022 318	6.3
Copper (2)	t	246 212	690 762	35.6	266 504	581 583	45.8	272 075	621 889	43.7
Lead (3)	t	87 466	150 019	58.3	92 557	155 369	59.6	81 365	143 303	56.8
Magnesium	t	(r) 32 790	x	x	43 850r	x	x	52 356	x	x
Manganese ore	t	7 339	–	..	5 755	–	..	5 928	–	..
Mercury	kg	2 803	–	..	x	–	x	x	–	x
Molybdenum (Mo content)	t	2 573	8 099	31.8	3 180	6 250	50.9	2 913	6 980	41.7
Nickel	t	(r) 19 787	197 947	10.0	(r) 22 527	176 749	12.7	24 976	181 139	13.8
Selenium	kg	9 762	397 876	2.5	12 447	358 759	3.5	8 747	334 689	2.6
Silver	kg	334 857	1 140 238	29.4	349 148	1 174 328	29.7	395 712	1 168 630	33.9
Tellurium	kg	x	62 274	x	x	63 945	x	x	53 228	x
Tin	t	2 753	–	..	2 791	–	..	2 845	–	..
Tungsten (W content)	kg	212 415	–	..	187 483	–	..	x	–	x
Zinc (3)	t	138 424	991 584	14	143 188	963 321	14.9	147 913	935 713	15.8
NONMETALS										
Barite	t	16 206	86 159	18.8	15 161	67 101	22.6	16 062	20 992	76.5
Feldspar	t	1 588	–	..	1 090	–	..	1 186	–	..
Fluorspar	t	92 822	–	..	79 157	–	..	94 905	–	..
Mica	t	3 606	x	x	3 692	x	x	3 994	x	x
Nepheline syenite	t	69 634	636 406	10.9	57 693	676 169	8.5	62 129	716 971	8.7
Phosphate rock	t	x	–	..	x	x	x	x	x	x
Potash (K_2O equivalent)	t	271 078	8 883 616	3.1	223 645	8 475 270	2.6	213 643	9 033 330	2.4
Sodium sulphate	t	117 131	258 249	45.4	109 647	x	x	112 003	x	x
Sulphur	t	765 093	9 240 245	8.3	746 890	9 498 810	7.9	767 346	9 451 926	8.1
Talc, etc.	t	82 696	72 095	114.7	75 815	79 493	95.4	78 821	84 945	92.8
MINERAL FUELS										
Coal	000 t	58 108	75 360	78.4	58 077	72 497	80.1	60 895	69 163	88.0
Crude oil (4)	000 m^3	95 435	128 401	74.3	(r) 96 947	122 247	(r) 79.3	100 564	127 809	78.7
Natural gas (5)	million m^3	45 608	160 515	28.4	45 154	162 219	27.8	47 943	167 790	28.6

Sources: Natural Resources Canada; Statistics Canada.
– Nil; . . Not available; (r) Revised; x Confidential.

(1) Use of primary and recycled aluminum and alloys, and scrap, reported by users. (2) "Use" is defined as domestic shipments of refined copper plus imports of refined copper. (3) Use of primary and recycled refined metal. (4) "Use" is defined as refinery receipts. (5) "Use" is defined as domestic sales.

Notes: Unless otherwise stated, "use" refers to reported use of refined metals or nonmetallic minerals by users. Production of metals, in most cases, refers to production in all forms, and includes the recoverable content of ores, concentrates, matte, etc., and the metal content of primary products recoverable at domestic smelters and refineries. Production of nonmetals refers to producers' shipments. For fuels, production is equivalent to actual output less waste.

TABLE 14. CANADA, DOMESTIC USE OF PRINCIPAL REFINED METALS IN RELATION TO REFINERY PRODUCTION,[1] 1994-2000

	Unit of Measure	1994	1995	1996	1997	1998	1999	2000
ALUMINUM								
Domestic use (2)	t	635 024	635 402	676 935	764 438	889 973	999 242	1 015 640
Production	t	2 254 683	2 171 992	2 283 212	2 327 188	2 374 118	2 389 834	2 373 460
Use as a percentage of production		28.2	29.3	29.6	32.8	37.5	41.8	42.8
COPPER								
Domestic use (3)	t	199 350	189 550	218 280	224 777	246 212	266 504	272 075
Production	t	549 869	572 616	559 200	560 582	562 261	548 563	551 393
Use as a percentage of production		36.3	33.1	39.0	40.1	43.8	48.6	49.3
LEAD								
Domestic use (4)	t	95 764	91 171	93 373	92 997	87 466	92 557	81 365
Production (5)	t	251 640	281 391	310 791	271 395	265 487	266 415	284 333
Use as a percentage of production		38.1	32.4	30.0	34.3	32.9	34.7	28.6
ZINC								
Domestic use (5)	t	122 118	130 735	134 787	133 553	138 424	143 188	147 913
Production	t	690 965	720 346	716 467	703 798	745 131	776 927	779 892
Use as a percentage of production		17.7	18.1	18.8	19.0	18.6	18.4	19.0

Source: Natural Resources Canada.

(1) Production of refined metal from all sources, including metal derived from recycled materials at primary refineries. (2) Use of primary and recycled aluminum and alloys, and scrap, reported by users. (3) "Use" is defined as domestic shipments of refined copper plus imports of refined copper. (4) Use of primary and recycled refined metal, reported by users. (5) Production of primary and recycled refined lead.

TABLE 15. AVERAGE ANNUAL PRICES[1] OF SELECTED METALS, 1994-2001

	Unit	1994	1995	1996	1997	1998	1999	2000	2001
Aluminum, London Metal Exchange	¢/lb	66.986	81.903	68.296	72.544	61.574	61.738	70.267	66.458
Antimony, New York dealer	$/lb	1.777	2.278	1.466	0.996	0.718	0.627	0.655	0.649
Bismuth, New York dealer	$/lb	3.070	3.781	3.546	3.275	3.408	3.378	3.539	3.613
Cadmium, New York dealer	$/lb	1.144	1.839	1.238	0.513	0.286	0.177	0.164	0.223
Copper, electrolytic cathode, COMEX	¢/lb	107.052	134.717	105.872	103.580	75.077	72.111	83.971	73.687
Gold, London (2)	$/troy oz	384.009	384.162	387.696	331.096	294.160	278.825	278.600	269.984
Iridium, New York dealer	$/troy oz	30.000	30.000	46.188	171.125	392.032	379.938	390.000	389.000
Lead, London Metal Exchange, cash	¢/lb	24.829	28.600	35.019	28.292	23.960	22.778	20.574	21.339
Magnesium, U.S. Spot Western Mean	¢/lb	144.744	191.894	187.236	165.759	159.238	155.229	137.229	125.406
Molbydenum, dealer, oxide	$/lb	4.501	7.412	3.606	4.175	3.313	2.591	2.498	2.313
Nickel, New York dealer, cathode	$/lb	2.919	3.901	3.501	3.221	2.179	2.750	3.987	2.825
Osmium, New York dealer	$/troy oz	400.000	399.375	392.458	391.000	366.867	350.000	350.000	350.800
Palladium, London PM fix	$/troy oz	142.631	151.229	128.079	177.951	284.678	357.902	681.100	651.676
Platinum, London PM fix	$/troy oz	404.998	424.346	397.171	395.210	372.019	376.880	544.226	546.169
Rhodium, New York dealer	$/troy oz	712.678	424.145	280.721	268.458	574.771	863.063	1 818.750	1 621.175
Ruthenium, New York dealer	$/troy oz	13.604	21.827	34.921	32.896	39.208	34.721	118.275	126.050
Selenium, New York dealer	$/lb	4.900	4.897	3.423	2.791	2.274	2.278	3.699	3.520
Silver, Handy & Harman	$/troy oz	5.284	5.192	5.183	4.892	5.534	5.250	5.003	4.414
Tantalum, tantalite ore, spot	$/lb	25.500	26.260	27.000	27.000	32.783	33.000	62.438	107.800
Tin, New York dealer	$/lb	2.549	2.945	2.890	2.644	2.613	2.545	2.549	2.156
Tungsten, US spot ore	$/stu	36.750	56.402	55.000	53.333	44.021	40.000	40.000	53.600
Uranium, U_3O_8	$/lb	14.000	13.000	15.100	14.200	13.300	12.700	12.400	. .
Zinc, special high grade	¢/lb	45.255	53.235	51.109	59.697	46.453	48.805	51.150	45.163

Sources: Natural Resources Canada; *Metals Week*.

. . Not available; COMEX Commodities Exchange, Inc.

(1) Prices, except where noted, are in U.S. currency. (2) Average afternoon fixings of London bullion dealers.

TABLE 16. CANADIAN AVERAGE ANNUAL PRICES OF SELECTED METALS, 1994-2001

	Unit	1994	1995	1996	1997	1998	1999	2000	2001
Aluminum, London Metal Exchange	$/kg	2.017	2.478	2.054	2.215	1.952	2.021	2.301	2.321
Antimony, New York dealer	$/kg	5.350	6.893	4.408	3.042	2.276	2.053	2.145	2.266
Bismuth, New York dealer	$/kg	9.243	11.441	10.663	10.000	10.805	11.059	11.588	12.617
Cadmium, New York dealer	$/kg	3.444	5.565	3.723	1.566	0.907	0.579	0.537	0.779
Copper, electrolytic cathode, COMEX	$/kg	3.223	4.076	3.184	3.163	2.380	2.361	2.749	2.573
Gold, London (1)	$/g	16.861	16.952	17.002	14.743	13.601	13.312	13.303	13.749
Iridium, New York dealer	$/g	1.317	1.324	2.026	7.620	18.126	18.139	18.623	19.811
Lead, London Metal Exchange, cash	¢/kg	54.739	63.052	77.204	62.373	52.823	50.217	45.358	47.044
Magnesium, U.S. Spot Western Mean	$/kg	4.631	5.462	5.804	5.496	5.707	5.893	5.894	4.379
Molbydenum, dealer, oxide	$/kg	13.552	22.428	10.844	12.748	10.504	8.482	8.179	8.077
Nickel, New York dealer, cathode	$/kg	8.789	11.804	10.528	9.835	6.908	9.003	13.055	9.865
Osmium, New York dealer	$/g	17.563	17.623	17.211	17.411	16.962	16.710	16.713	17.865
Palladium, London PM fix	$/g	6.263	6.673	5.617	7.924	13.162	17.087	35.523	33.188
Platinum, London PM fix	$/g	17.783	18.725	17.417	17.598	17.201	17.993	25.987	27.815
Rhodium, New York dealer	$/g	31.292	18.716	12.311	11.954	26.575	41.205	86.846	82.561
Ruthenium, New York dealer	$/g	0.597	0.963	1.531	1.465	1.813	1.658	5.648	6.419
Selenium, New York dealer	$/kg	14.753	14.818	10.293	8.522	7.210	7.458	12.112	12.292
Silver, Handy & Harman	$/kg	232.011	229.107	227.293	217.835	255.870	250.653	238.895	224.791
Tantalum, tantalite ore, spot	$/kg	76.777	79.459	81.192	82.442	103.937	108.034	204.441	376.450
Tin, New York dealer	$/kg	7.675	8.911	8.690	8.075	8.284	8.333	8.346	7.529
Tungsten, US spot ore	$/mtu	49.397	76.189	73.835	72.700	62.307	58.460	58.470	83.561
Uranium, U_3O_8	$/kg	51.000	47.000	53.600	51.300	51.100	49.100	49.700	. .
Zinc, special high grade	$/kg	1.363	1.611	1.537	1.823	1.473	1.598	1.675	1.577

Sources: Natural Resources Canada; *Metals Week*.

. . Not available; COMEX Commodities Exchange, Inc.; mtu Metric tonne unit.

(1) Average afternoon fixings of London bullion dealers.

TABLE 17. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY, (1) 1999

		Mining Activity							Total Activity (2)		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
BY INDUSTRY											
Metals											
Gold	45	6 279	13 741	411 956	154 359	656 922	2 124 768	1 313 487	8 215	551 848	1 304 130
Silver-lead-zinc	5	1 639	3 595	93 420	37 966	588 686	1 014 382	387 730	2 422	148 757	387 800
Iron	4	3 654	7 859	287 731	151 986	418 939	1 323 200	752 275	4 667	368 633	744 330
Nickel-copper-zinc	19	8 604	17 999	500 019	155 614	1 611 675	4 093 395	2 326 105	11 456	721 952	2 349 024
Miscellaneous metal mines (3)	9	1 406	2 928	77 083	49 140	137 465	640 437	453 832	1 767	101 378	453 795
Total	82	21 582	46 122	1 370 216	549 066	3 413 687	9 196 182	5 233 429	28 527	1 892 568	5 239 078
Nonmetals											
Peat	74	1 582	3 523	43 784	9 380	51 448	263 790	202 982	1 868	53 844	204 534
Gypsum	9	567	1 250	23 197	8 191	18 957	111 721	84 573	680	28 808	84 429
Potash	11	2 517	5 335	145 135	139 836	180 257	1 583 481	1 383 389	3 378	222 900	1 382 897
Salt	10	1 028	2 289	51 410	17 428	42 881	358 348	296 261	1 451	76 548	296 418
Diamond	21	1 482	3 048	64 737	33 973	54 888	265 511	176 650	1 926	92 183	176 126
Stone	172	2 796	8 140	111 946	53 984	145 065	664 168	465 119	3 526	147 073	469 750
Sand and gravel	400	3 234	7 468	124 148	54 273	97 771	637 637	485 593	4 358	180 996	494 085
Shale, clay and refractory minerals	8	167	351	7 815	4 108	11 526	64 781	49 147	205	10 444	49 040
Miscellaneous nonmetals (4)	1	332	669	23 240	18 313	51 820	609 989	530 856	387	26 235	538 356
Total	706	13 685	30 051	595 413	339 464	634 392	4 637 426	3 663 570	17 781	828 183	3 675 645
Mineral Fuels											
Coal	30	5 809	11 676	335 791	123 436	401 684	1 458 494	931 394	7 117	424 842	938 701
Total mineral industry	818	41 076	87 849	2 301 420	1 011 965	4 449 744	15 290 102	9 828 393	53 425	3 145 593	9 853 424
BY REGION											
Atlantic provinces	91	5 478	11 674	308 006	119 373	654 578	1 725 589	951 648	6 795	382 951	946 940
Quebec	200	8 283	18 138	470 426	228 634	908 045	2 709 808	1 573 129	11 372	671 918	1 582 995
Ontario	286	10 804	24 038	603 245	206 371	1 187 011	4 129 376	2 735 995	14 377	856 470	2 734 561
Prairie provinces	161	9 528	19 806	496 838	269 639	689 023	3 636 553	2 677 892	12 116	682 939	2 688 596
British Columbia	72	6 165	12 305	387 056	149 195	772 711	2 107 820	1 185 915	7 541	464 107	1 186 938
Yukon and Northwest Territories	8	818	1 890	57 845	38 753	238 378	980 946	703 818	1 224	87 210	703 394
Total Canada	818	41 076	87 849	2 301 420	1 011 965	4 449 744	15 290 102	9 828 393	53 425	3 145 593	9 853 424

Sources: Natural Resources Canada; Statistics Canada.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Total activity includes sales and head offices. (3) Includes molybdenum and uranium.

(4) Includes asbestos.

Notes: This table no longer includes data for the petroleum and natural gas industries. Numbers may not add to totals due to rounding.

TABLE 18. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, 1999

	Mineral Manufacturing Activity								Total Activity (1)		
		Production and Related Workers			Costs						
	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
BY INDUSTRY											
Primary metal manufacturing	478	75 594	151 816	3 778 168	2 011 659	15 474 337	31 111 101	13 261 554	93 658	4 978 159	13 287 736
Nonmetallic mineral product manufacturing	1 354	36 462	75 155	1 381 768	602 068	3 503 990	8 925 938	4 864 745	45 761	1 907 671	5 078 855
Fabricated metal product manufacturing	4 283	140 721	305 277	4 610 152	384 142	11 981 679	24 101 014	11 842 183	166 245	5 994 861	12 180 575
Petroleum and coal products manufacturing	204	6 691	14 448	401 262	445 028	18 023 925	20 519 165	2 384 650	12 829	824 229	3 417 020
Total	6 319	259 468	546 696	10 171 350	3 442 897	48 983 931	84 657 218	32 353 132	318 493	13 704 920	33 964 186
BY REGION											
Atlantic	268	x	x	x	x	x	x	x	x	x	x
Quebec	1 568	61 088	123 295	2 323 356	1 281 437	11 917 928	23 081 892	9 980 389	80 286	3 341 501	10 458 987
Ontario	2 739	141 321	302 919	5 732 464	1 522 019	23 376 580	41 262 804	16 293 962	169 223	7 486 065	17 302 988
Prairies	1 005	x	x	x	x	x	x	x	x	x	x
British Columbia	739	x	x	x	x	x	x	x	x	x	x
Total	6 319	259 468	546 696	10 171 350	3 442 897	48 983 931	84 657 218	32 353 132	318 493	13 704 920	33 964 186

Source: Statistics Canada.
x Confidential.
(1) Total activity includes sales and head offices.

TABLE 19. CANADA, PRINCIPAL STATISTICS OF THE MINERAL INDUSTRY,[1] 1989-1999

		Mining Activity							Total Activity (2)		
		Production and Related Workers			Costs						
Year	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1989	537	59 593	129 946	2 562 805	1 013 010	4 712 423	17 445 454	11 720 021	78 270	3 460 051	11 826 346
1990	521	55 558	121 448	2 510 817	1 061 769	4 619 245	16 158 688	10 477 673	73 156	3 391 151	10 571 448
1991	496	51 642	112 344	2 446 055	1 043 554	4 318 454	14 359 030	8 997 022	68 747	3 363 119	9 094 572
1992	469	46 819	101 065	2 278 504	960 413	4 249 868	13 705 148	8 494 868	62 257	3 136 794	8 566 223
1993	459	44 053	94 733	2 139 903	933 552	3 931 954	12 598 992	7 733 486	58 325	2 928 793	7 793 020
1994	555	44 083	95 756	2 227 755	970 304	3 938 223	13 872 683	8 964 128	58 195	3 019 806	9 059 983
1995	730	46 728	101 852	2 421 274	1 065 118	4 652 556	16 771 037	11 053 363	61 193	3 262 475	11 133 393
1996 (r)	727	45 552	99 532	2 466 512	1 129 784	4 939 053	16 568 618	10 499 781	59 555	3 306 371	10 575 169
1997 (r)	717	45 011	98 314	2 550 807	1 116 321	5 118 922	16 907 365	10 672 121	58 326	3 307 931	10 744 485
1998	708	42 554	92 746	2 437 877	1 056 510	4 920 070	16 172 637	10 196 057	56 929	3 309 255	10 254 270
1999	818	41 076	87 849	2 301 420	1 011 966	4 449 744	15 290 102	9 828 393	53 425	3 145 593	9 853 424

Sources: Natural Resources Canada; Statistics Canada.
(r) Revised.
(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Total activity includes sales and head offices.
Note: This table no longer includes date for the petroleum and natural gas industries.

TABLE 20. CANADA, PRINCIPAL STATISTICS OF THE MINERAL MANUFACTURING INDUSTRIES, [(1)] 1982-1999

	Mineral Manufacturing Activity								Total Activity (2)		
		Production and Related Workers			Costs						
Year	Establishments	Employees	Person-Hours Paid	Wages	Fuel and Electricity	Materials and Supplies	Value of Production	Value Added	Employees	Salaries and Wages	Value Added
	(number)	(number)	(000)	($000)	($000)	($000)	($000)	($000)	(number)	($000)	($000)
1982	5 687	229 518	475 378	5 333 201	1 728 740	34 241 605	50 045 037	14 497 245	321 785	8 126 238	14 823 990
1983	7 370	216 944	447 947	5 420 307	1 905 777	34 720 416	52 773 875	15 861 491	301 112	8 143 674	16 196 749
1984	7 511	223 816	470 367	5 948 626	2 125 032	37 738 117	57 207 764	17 980 271	304 309	8 719 151	18 265 131
1985	7 625	238 544	506 377	6 507 081	2 229 270	39 497 925	61 241 939	19 305 730	313 850	9 271 447	19 646 938
1986	7 841	248 039	524 184	6 829 899	2 096 145	31 806 478	54 521 641	19 788 464	319 950	9 563 918	20 124 687
1987	7 598	. .	. .	. .	2 154 276	35 570 988	59 787 220	22 189 903	333 536	10 188 110	22 733 514
1988	8 309	277 965	586 697	8 187 249	2 268 149	35 436 715	62 739 083	25 125 477	350 917	11 191 039	25 725 203
1989	8 300	288 494	606 841	8 893 139	2 341 578	38 785 940	64 981 175	24 317 984	360 004	12 014 330	29 859 105
1990	8 333	260 693	549 440	8 469 361	2 335 229	38 305 154	63 081 826	22 679 757	333 962	11 722 025	23 262 830
1991	7 820	242 783	510 984	8 226 481	2 456 144	34 628 749	58 093 646	20 169 425	309 678	11 288 852	20 698 450
1992	7 482	214 862	489 072	7 656 558	2 530 479	34 191 776	56 436 631	19 375 600	280 226	10 708 582	19 829 810
1993	7 202	211 316	381 263	7 656 373	2 641 864	35 060 212	58 685 636	21 008 722	273 767	10 688 689	21 445 279
1994	7 099	217 412	397 045	7 950 383	2 754 778	38 575 016	65 490 301	24 565 574	279 983	11 040 491	24 993 941
1995	7 151	230 185	492 240	8 537 700	2 862 100	41 112 900	71 292 500	27 936 100	293 594	11 841 500	28 766 000
1996	8 300	230 308	492 074	8 800 500	2 899 400	45 735 300	76 736 600	28 010 400	292 357	12 077 700	28 424 000
1997	8 057	256 877	540 163	9 830 200	3 110 100	48 440 400	81 124 600	29 829 800	321 152	13 447 700	30 254 500
1998	6 823	259 407	551 694	9 920 386	3 283 131	45 004 087	77 701 305	29 695 431	316 936	13 231 170	30 865 463
1999	6 319	259 468	546 696	10 171 350	3 442 897	49 963 931	84 657 218	32 353 132	318 493	13 704 920	33 964 186

Source: Statistics Canada.

. . Not available.

(1) Includes the following industries: primary metals, nonmetallic mineral products, fabricated metal products, and petroleum and coal products. (2) Total activity includes sales and head offices.

TABLE 21. CANADA, CONSUMPTION OF FUEL AND ELECTRICITY IN THE NON-FUEL MINERAL INDUSTRY,(1) 1999

	Unit	Metals	Nonmetals (2)	Total
Coal	000 t	–	–	–
	$000	–	–	–
Gasoline	000 litres	17 829	21 048	38 877
	$000	8 852	10 397	19 249
Fuel oil, kerosene, diesel oil	000 litres	575 153	285 224	860 377
	$000	132 608	105 672	238 280
Liquefied petroleum gas	000 litres	115 883	11 931	127 814
	$000	24 565	2 701	27 266
Natural gas	000 m^3	91 413	804 157	895 570
	$000	12 462	86 119	98 581
Other fuels (3)	$000	34 863	502	35 365
Total value of fuels	$000	213 351	205 391	418 742
Electricity purchased	million kWh	9 415	2 811	12 226
	$000	335 715	134 072	469 787
Total value of fuels and electricity purchased, all reporting companies	$000	549 066	339 464	888 530

Sources: Natural Resources Canada; Statistics Canada.

– Nil.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry.

(2) Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory minerals.

(3) Includes wood, manufactured gas, steam purchased, and other miscellaneous fuels.

Notes: Numbers may not add up to totals due to rounding.

TABLE 22. CANADA, COST OF FUEL AND ELECTRICITY USED IN THE NON-FUEL MINERAL INDUSTRY,(1) 1995-99

	Unit	1995	1996	1997	1998	1999
METALS						
Fuel	$000	237 376	289 723	283 375	244 801	213 351
Electricity purchased	million kWh	11 527	11 248	11 186	10 754	9 415
	$000	408 270	396 358	383 009	375 095	335 715
Total cost of fuel and electricity	$000	645 646	686 082	666 384	619 896	549 066
NONMETALS (2)						
Fuel	$000	91 148	87 173	95 245	172 842	205 392
Electricity purchased	million kWh	2 363	2 333	2 369	2 760	2 811
	$000	109 676	107 876	96 917	130 203	134 072
Total cost of fuel and electricity	$000	200 824	195 049	192 162	303 045	339 464
TOTAL NON-FUEL MINERAL INDUSTRY						
Fuel	$000	387 133	441 668	444 390	417 643	418 743
Electricity purchased	million kWh	14 270	14 016	13 981	13 514	12 226
	$000	543 219	533 507	509 277	505 298	469 787
Total cost of fuel and electricity	$000	930 353	975 176	953 667	922 941	888 530

Sources: Natural Resources Canada; Statistics Canada.

(1) Cement manufacturing and lime manufacturing are included in the mineral manufacturing industry. (2) Includes all nonmetallic minerals, stone, sand and gravel, shale, clay and refractory materials.

Notes: Numbers may not add to totals due to rounding. This table does not include data for the coal industry.

TABLE 23. CANADA, EMPLOYMENT IN THE MINERAL INDUSTRY, STAGE I – MINERAL EXTRACTION AND CONCENTRATING (TOTAL ACTIVITY),[1] 1961-2001

Year	Metal Mines	Nonmetal Mines (2)	Non-Fuel Minerals	Coal	Total
NAICS no.	2122	2123	2133, 2123	21211	2122, 2123, 21211
			(number)		
1961	58 591	16 238	74 829	10 302	85 131
1962	58 243	16 922	75 165	9 897	85 062
1963	57 119	17 347	74 466	9 828	84 294
1964	57 648	17 771	75 419	9 796	85 215
1965	60 942	18 364	79 306	9 697	89 003
1966	61 670	18 734	80 404	9 281	89 685
1967	61 728	18 856	80 584	8 981	89 565
1968	63 369	19 509	82 878	8 427	91 305
1969	60 550	20 014	80 564	7 371	87 935
1970	66 590	20 660	87 250	7 874	95 124
1971	66 012	20 433	86 445	8 069	94 514
1972	61 994	20 020	82 014	8 704	90 718
1973	66 134	20 667	86 801	7 856	94 657
1974	70 038	22 395	92 433	8 142	100 575
1975	69 161	20 085	89 246	8 416	97 662
1976	68 269	21 334	89 603	8 995	98 598
1977	67 242	21 798	89 040	9 781	98 821
1978	56 447	20 882	77 329	10 574	87 903
1979	58 960	21 462	80 422	10 269	90 691
1980	66 118	21 440	87 558	11 416	98 974
1981	68 712	20 574	89 286	11 182	100 468
1982	61 503	17 171	78 674	13 113	91 787
1983	52 194	16 573	68 767	11 646	80 413
1984	52 683	17 258	69 941	11 905	81 846
1985	48 672	16 915	65 587	12 076	77 663
1986	46 487	17 263	63 750	10 747	74 497
1987	45 496	17 919	63 415	10 406	73 821
1988	48 277	17 596	65 873	11 122	76 995
1989	49 395	17 595	66 990	11 279	78 269
1990	45 248	16 891	62 139	11 017	73 156
1991	42 092	15 838	57 930	10 817	68 747
1992	37 774	14 757	52 531	9 726	62 257
1993	34 746	14 719	49 465	8 860	58 325
1994	33 380	15 927	49 307	8 888	58 195
1995	35 181	16 948	52 129	9 063	61 192
1996	34 257	16 121	50 378	9 177	59 555
1997	33 012	16 376	49 388	8 938	58 326
1998	30 734	17 038	47 772	8 157	55 929
1999	28 527	17 781	46 308	7 058	53 366
2000 (p)	27 807	17 788	45 595	5 850	51 445
2001 (f)	23 485	16 899	40 384	6 039	46 423

Sources: Natural Resources Canada; Statistics Canada.

NAICS: North American Industrial Classification System.

(f) Forecast; (p) Preliminary.

(1) Total activity includes sales and head offices. (2) Includes structural materials.

TABLE 24. CANADA, NON-FUEL MINERAL INDUSTRY EMPLOYMENT, BY STAGE, 1990-2001

Year	Stage I	Stage II	Stage III	Stage IV	Total
			(number)		
1990	73 156	69 579	92 846	150 431	386 015
1991	68 747	67 075	84 981	135 564	356 367
1992	62 257	60 848	78 606	121 497	323 209
1993	58 325	58 054	75 293	117 703	309 378
1994	58 195	54 997	77 440	124 227	314 862
1995	61 192	55 518	79 519	135 124	331 353
1996	59 555	58 133	82 364	145 262	345 314
1997	58 326	58 280	82 812	160 939	360 359
1998	55 929	57 707	83 201	180 505	377 345
1999	53 366	57 514	81 943	182 349	375 173
2000 (p)	51 445	58 964	86 252	192 249	388 911
2001 (f)	46 423	53 878	83 779	191 705	375 784

Sources: Natural Resources Canada; Statistics Canada.

(f) Forecast; (p) Preliminary.

Note: Numbers may not add to totals due to rounding.

TABLE 25. CANADA, NUMBER OF WAGES EARNERS EMPLOYED IN THE NONFUEL MINERAL INDUSTRY (SURFACE, UNDERGROUND AND MILL), 1992-99

	1992	1993	1994	1995	1996	1997	1998	1999
					(number)			
METALS								
Surface	6 550	5 973	4 526	4 467	6 358	4 762	5 192	4 847
Underground	12 205	11 281	11 396	12 305	10 610	11 556	9 269	8 468
Mill	9 153	8 508	8 888	9 572	8 862	8 803	8 601	8 267
Total	27 908	25 762	24 810	26 344	25 830	25 121	23 062	21 582
NONMETALS								
Surface	4 553	4 620	5 318	6 369	6 051	6 185	6 286	6 770
Underground	2 125	2 098	2 093	1 967	1 926	1 964	2 009	2 008
Mill	4 429	4 369	4 591	4 625	4 211	4 392	4 506	4 907
Total	11 107	11 087	12 002	12 961	12 188	12 541	12 800	13 685
TOTAL NON-FUEL MINERAL INDUSTRY								
Surface	11 103	10 593	9 844	10 836	12 409	10 947	11 478	11 617
Underground	14 330	13 379	13 489	14 272	12 536	13 520	11 278	10 476
Mill	13 582	12 877	13 479	14 197	13 073	13 195	13 107	13 174
Total	39 015	36 849	36 812	39 305	38 018	37 662	35 862	35 267

Sources: Natural Resources Canada; Statistics Canada.

Note: Numbers may not add to totals due to rounding.

TABLE 26. CANADA, MINE AND MILL WORKERS, BY SEX, EMPLOYED IN THE NON-FUEL MINERAL INDUSTRY, 1999

	Mine Workers							
	Underground		Surface		Mill Workers		Total	
	Male	Female	Male	Female	Male	Female	Male	Female
METALS								
Gold	3 460	29	931	45	1 751	63	6 142	137
Silver-lead-zinc	826	5	92	5	692	19	1 610	29
Iron ore	–	–	849	28	2 651	126	3 500	154
Nickel-copper-zinc	3 980	22	2 308	28	2 178	88	8 466	138
Miscellaneous metal mines	146	0	542	19	651	48	1339	67
Total	8 412	56	4 722	125	7 923	344	21 057	525
NONMETALS								
Peat	–	–	523	47	949	63	1 472	110
Gypsum	124		330	1	110	2	564	3
Potash	1 174	18	40	1	1 249	35	2 463	54
Salt	508	1	154	5	350	10	1 012	16
Diamond	–	–	188	2	121	21	309	23
Stone	–	–	2 017	20	738	21	2 755	41
Sand and gravel	–	–	2 830	75	324	5	3 154	80
Shale, clay and refractory minerals	–	–	42		124	1	166	1
Miscellaneous nonmetals	183	–	493	2	771	13	1447	15
Total	1 989	19	6 617	153	4 736	171	13 342	343
Total non-fuel mineral industry	10 401	75	11 339	278	12 659	515	34 399	868

Sources: Natural Resources Canada; Statistics Canada.
– Nil.

TABLE 27. CANADA, LABOUR COSTS FOR METAL MINES IN RELATION TO TONNES MINED, 1997-99

	Number of Wage Earners	Total Wages	Average Annual Wage	Tonnage of Ore Mined	Average Annual Tonnes Mined Per Wage Earner	Wage Cost Per Tonne Mined
	(no.)	($000)	($)	(000 t)	(t)	($)
1997						
Gold	5 142	353 561	68 759	33 924	6 597	10.42
Nickel-copper-zinc	7 738	465 700	60 183	94 892	12 263	4.91
Silver-lead-zinc	1 531	71 962	47 003	9 608	6 276	7.49
Iron ore	1 010	80 658	79 860	94 430	93 495	0.85
Miscellaneous metals	897	51 469	117 709	15 145	28 894	3.40
Total	16 318	1 023 349	62 713	247 999	15 198	4.13
1998						
Gold	4 582	319 026	69 626	36 454	7 956	8.75
Nickel-copper-zinc	7 039	434 680	61 753	102 694	14 589	4.23
Silver-lead-zinc	1 035	61 142	59 074	8 484	8 197	7.21
Iron ore	953	78 769	82 654	96 743	101 514	0.81
Miscellaneous metals	852	49 071	116 496	15 519	30 148	3.16
Total	14 461	942 688	65 188	259 893	17 972	3.63
1999						
Gold	4 465	300 154	67 224	44 799	10 033	6.70
Nickel-copper-zinc	6 338	385 682	60 852	71 829	11 333	5.37
Silver-lead-zinc	928	55 288	59 578	7 808	8 414	7.08
Iron ore	877	74 421	84 859	85 249	97 205	0.87
Miscellaneous metals	707	39 919	118 015	14 617	32 605	2.73
Total	13 315	855 465	64 248	224 302	16 846	3.81

Sources: Natural Resources Canada; Statistics Canada.
Note: Numbers may not add to totals due to rounding.

TABLE 28. CANADA, PERSON-HOURS PAID FOR PRODUCTION AND RELATED WORKERS, AND TONNES OF ORE MINED AND ROCK QUARRIED IN METAL MINES AND OTHER MINERAL OPERATIONS, 1994-99

	Unit	1994 (r)	1995 (r)	1996 (r)	1997 (r)	1998 (r)	1999
METAL MINES (1)							
Ore mined	Mt	233.70	260.50	253.00	248.00	259.90	224.30
Person-hours paid (2)	million	53.70	57.10	56.10	54.60	50.20	46.10
Person-hours paid per tonne mined	number	0.23	0.22	0.22	0.22	0.19	0.21
Tonnes mined per person-hour paid	t	4.35	4.56	4.51	4.54	5.18	4.87
OTHER MINERAL OPERATIONS (3)							
Ore mined and rock quarried	Mt	170.50	173.00	167.90	178.40	167.50	152.10
Person-hours paid (2)	million	29.80	29.30	32.10	29.00	26.70	23.50
Person-hours paid per tonne mined	number	0.17	0.17	0.19	0.16	0.16	0.15
Tonnes mined per person-hour paid	t	5.73	5.90	5.23	6.16	6.27	6.50

Sources: Natural Resources Canada; Statistics Canada, catalogue nos. 26-201, 26-223 and 26-206.
(r) Revised.
(1) Excludes placer mining. (2) Person-hours paid for production and related workers only. (3) Includes asbestos, potash, gypsum, salt, miscellaneous nonmetals and coal.

TABLE 29. CANADA, AVERAGE WEEKLY WAGES (INCLUDING OVERTIME) FOR HOURLY RATED EMPLOYEES IN THE MINING, MINERAL MANUFACTURING, AND LOGGING AND FORESTRY INDUSTRIES, 1993-2001

	1993	1994	1995	1996	1997	1998	1999	2000	2001
					($)				
Oil and gas extraction	1 146.70	1 171.54	1 208.05	1 242.71	1 252.70	1 298.43	1 333.92	1 352.43	1 380.33
Mining	903.89	921.83	963.25	1 001.83	998.87	1 053.39	1 039.90	1 094.11	1 090.31
Coal mining	973.49	989.79	1 028.06	1 057.58	1 045.80	1 138.11	1 126.95	1 204.74	1 232.08
Metal ore mining	975.93	1 002.30	1 049.60	1 078.85	1 053.23	1 127.77	1 123.25	1 168.98	1 168.94
Nonmetallic mineral mining and quarrying	738.78	755.07	784.51	825.18	873.86	893.33	882.64	944.20	943.49
Support activities for mining and oil and gas extraction	817.90	816.27	817.21	895.53	948.30	978.06	970.21	1 013.57	1 049.05
Mineral manufacturing activities	688.88	705.67	712.75	733.82	752.42	770.92	782.43	796.89	808.12
Forestry, logging and support	680.11	700.01	697.64	745.69	786.46	766.33	773.42	810.15	830.84

Source: Statistics Canada; *Annual Estimates of Employment, Earnings and Hours* .

TABLE 30. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY INDUSTRY, 1999-2001

	1999			2000			2001 (p)		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
Agriculture	1	11	60	1	227	24 800	4	613	23 300
Logging and forestry	7	2 002	118 290	5	13 150	101 010	3	669	2 320
Fishing and trapping	–	–	–	–	–	–	–	–	–
Mining	8	2 676	150 580	9	3 625	160 210	11	3 852	106 430
Utilities	7	3 214	178 350	1	5	70	5	842	17 380
Construction	8	1 014	6 420	7	865	15 540	6	16 110	86 610
Manufacturing	122	25 143	453 470	129	21 450	403 720	117	17 214	530 950
Wholesale and retail trade	42	2 406	79 380	33	9 625	89 670	39	3 570	130 040
Transportation and utilities	25	17 631	102 660	35	4 737	79 510	35	8 262	366 095
Information and culture	18	16 016	473 290	10	3 761	69 810	11	2 966	43 080
Finance, insurance and real estate	27	1 257	70 410	24	2 498	59 900	18	5 153	41 870
Education, health and social sciences	75	75 801	497 590	65	41 820	307 460	73	109 637	585 950
Entertainment and hospitality	37	5 413	105 200	34	5 845	130 860	38	3 841	85 930
Public administration	36	6 028	210 190	24	35 962	219 060	19	51 032	219 590
Total, all industries	413	158 612	2 445 890	377	143 570	1 661 620	379	223 761	2 239 545

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; (p) Preliminary.

TABLE 31. CANADA, NUMBER OF STRIKES AND LOCKOUTS BY MINING AND MINERAL MANUFACTURING INDUSTRY, 1999-2001

	1999			2000			2001 (p)		
	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days	Strikes and Lockouts	Workers Involved	Duration in Person-Days
					(number)				
MINING	8	2 676	150 580	9	3 625	160 210	11	3 852	106 430
Metals	4	2 174	137 280	3	1 710	140 200	7	3 089	98 400
Mineral fuels	1	250	250	3	1 629	15 830	–	–	–
Nonmetals	2	225	8 330	2	245	3 710	4	763	8 030
Quarries	1	27	4 720	1	41	470	–	–	–
MINERAL MANUFACTURING	11	705	18 110	21	2 384	70 410	11	1 384	45 800
Primary metals	2	116	8 010	3	1 010	32 630	6	1 196	42 310
Nonmetallic mineral products	9	589	10 100	17	874	34 780	5	188	3 490
Petroleum and coal products	–	–	–	1	500	3 000	–	–	–

Source: Human Resources Development Canada, Workplace Information Directorate.
– Nil; (p) Preliminary.

TABLE 32. CANADA, MINING WAGES AND SALARIES BY PROVINCE, TERRITORY AND MINERAL CLASS, 1998 AND 1999

	1998				1999			
Province/Territory	Metals	Nonmetals	Coal	Total	Metals	Nonmetals	Coal	Total
					($000)			
Newfoundland and Labrador	178 355	3 479	–	181 834	178 253	5 190	–	183 443
Prince Edward Island	–	1 104	–	1 104	–	948	–	948
Nova Scotia	–	39 679	54 043	93 722	–	41 006	40 814	81 820
New Brunswick	78 070	46 642	3 484	128 197	x	x	3 892	116 740
Quebec	511 915	162 788	–	674 703	508 233	163 683	–	671 916
Ontario	697 669	186 831	–	884 500	642 494	213 976	–	856 470
Manitoba	197 115	11 844	–	208 959	166 513	13 586	–	180 099
Saskatchewan	x	226 705	x	317 680	x	218 165	x	305 173
Alberta	–	x	x	224 969	–	x	x	197 667
British Columbia	245 434	37 752	229 892	513 078	207 235	40 311	216 561	464 107
Yukon, Northwest Territories and Nunavut	x	x	–	80 509	x	x	–	87 210
Total	2 049 090	790 861	469 303	3 309 255	1 892 568	828 183	424 842	3 145 593

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Notes: This table no longer includes data for the petroleum and natural gas industries.

TABLE 33. SOURCE OF ORES HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1997-99

	1997			1998			1999		
	Underground	Open-Pit	Total	Underground	Open-Pit	Total	Underground	Open-Pit	Total
					(000 tonnes)				
METALS									
Gold	18 060	15 864	33 924	16 579	19 875	36 454	15 810	28 989	44 799
Silver-lead-zinc	7 834	1 773	9 608	8 310	174	8 484	7 808	–	7 808
Iron ore	663	93 767	94 430	372	96 371	96 743	–	85 249	85 249
Nickel-copper-zinc	26 504	68 388	94 892	25 483	77 212	102 694	23 680	48 149	71 829
Miscellaneous metals	1 594	13 551	15 145	1 402	14 117	15 519	1 208	13 409	14 617
Total metals	54 656	193 343	247 999	52 145	207 748	259 893	48 506	175 796	224 302
NONMETALS									
Asbestos	x	x	x	x	x	x	x	x	x
Gypsum	1 114	8 027	9 141	977	7 885	8 863	1 037	8 627	9 665
Potash	38 932	–	38 932	39 514	–	39 514	29 346	–	29 346
Rock salt	12 690	–	12 690	13 277	–	13 277	11 816	–	11 816
Diamonds	–	–	–	–	402	402	–	3 166	3 166
Miscellaneous nonmetals	x	x	x	x	x	x	x	x	x
Total nonmetals	54 671	21 183	75 853	55 645	16 495	72 140	43 714	20 069	63 784
MINERAL FUELS									
Coal	4 730	97 005	101 735	3 910	91 453	95 363	2 333	85 939	88 272
Grand total	114 057	311 531	425 587	111 700	315 697	427 396	94 553	281 804	376 357
Percentage	26.80	73.20	100.00	26.14	73.87	100.00	25.12	74.88	100.00

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 34. SOURCE OF MATERIAL HOISTED OR REMOVED FROM SELECTED TYPES OF MINES, 1999

	Underground Ore	Underground Waste	Open-Pit Ore	Open-Pit Waste	Open-Pit Overburden	Open-Pit Tailings
				(000 tonnes)		
METALS						
Gold	15 810	3 864	28 989	44 170	4 991	42 505
Silver-lead-zinc	7 808	431	–	547	–	6 364
Iron ore	–	–	85 249	7 067	9 466	51 745
Nickel-copper-zinc	23 680	1 077	48 149	43 614	190	68 053
Miscellaneous metals	1 208	192	13 409	10 503	–	10 985
Total metals	48 506	5 563	175 796	105 901	14 646	179 653
NONMETALS						
Asbestos	x	x	x	x	x	x
Gypsum	1 037	145	8 627	2 521	1 094	77
Potash	29 346	5 857	–	–	–	11 316
Rock salt	11 815	549	–	–	–	509
Diamonds	–	–	3 166	24 321	–	–
Miscellaneous nonmetals	x	x	x	x	x	x
Total nonmetals	42 198	6 552	20 069	44 802	1 201	16 637
MINERAL FUELS						
Coal	2 333	. .	85 939	. .	. .	. .
Total metals, nonmetals and mineral fuels	94 553	12 115	281 804	150 703	15 847	196 290

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential; . . Not available.
Note: Numbers may not add to totals due to rounding.

TABLE 35. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1995-99

Mines	1995	1996	1997	1998	1999
			(000 tonnes)		
METALS					
Gold	25 120	30 901	33 924	36 454	44 799
Silver-lead-zinc	10 295	11 656	9 608	8 484	7 808
Iron ore	95 538	95 783	94 430	96 743	85 249
Nickel-copper-zinc	113 259	98 671	94 892	102 694	71 829
Miscellaneous metals	16 263	15 992	15 145	15 519	14 617
Total metals	260 475	253 003	247 999	259 893	224 302
NONMETALS					
Asbestos	x	x	x	x	x
Gypsum	8 623	8 584	9 141	8 863	9 665
Potash	40 196	34 103	38 932	39 514	29 346
Rock salt	9 854	11 226	12 690	13 277	11 816
Diamonds	–	–	–	402	3 166
Miscellaneous nonmetals	x	x	x	x	x
Total nonmetals	72 596	67 491	75 853	72 140	63 784
STRUCTURAL MATERIALS					
Stone of all kinds quarried	120 660	112 420	120 953	129 057	130 226
Sand and gravel	230 098	217 361	227 315	231 639	248 311
MINERAL FUELS					
Coal	97 707	100 359	101 735	95 363	88 272
Total ore mined and rock quarried	781 536	750 634	773 855	788 092	754 895

Sources: Natural Resources Canada; Statistics Canada.
– Nil; x Confidential.
Note: Numbers may not add to totals due to rounding.

TABLE 36. CANADA, ORE MINED AND ROCK QUARRIED IN THE MINING INDUSTRY, 1961-99

Year	Metals	Industrial Minerals (1)	Coal	Total
		(million tonnes)		
1961	90.1	96.7	..	186.8
1962	103.6	103.8	..	207.4
1963	112.7	120.4	..	233.1
1964	128.0	134.1	..	262.1
1965	151.0	146.5	..	297.5
1966	147.6	171.8	..	319.4
1967	169.1	177.5	..	346.6
1968	186.9	172.7	..	359.6
1969	172.0	178.8	..	350.8
1970	213.0	179.1	..	392.1
1971	211.5	185.8	..	397.3
1972	206.0	189.7	..	395.7
1973	274.9	162.6	..	437.4
1974	278.7	178.8	..	457.5
1975	264.2	158.7	..	422.9
1976	296.5	167.1	..	463.6
1977	299.5	205.2	33.8	538.5
1978	248.1	205.5	36.3	489.9
1979	274.8	200.1	39.8	514.6
1980	290.1	193.5	43.9	527.5
1981	301.5	172.5	48.2	522.2
1982	238.4	121.2	53.0	412.5
1983	219.0	137.0	54.8	410.8
1984	246.4	167.8	71.2	485.4
1985	245.0	171.9	76.7	493.6
1986	256.3	179.1	72.7	508.2
1987	266.2	197.5	77.5	541.1
1988	282.1	210.3	89.3	581.6
1989	283.8	209.4	87.7	580.9
1990	280.6	195.4	89.5	565.4
1991	271.4	166.4	90.3	528.0
1992	248.2	169.2	81.4	498.8
1993	236.5	167.9	87.6	458.4
1994	233.7	184.3	96.6	514.6
1995	260.5	193.3	97.7	551.4
1996	253.0	179.9	100.4	533.3
1997 (r)	248.0	196.8	101.7	546.5
1998	259.9	201.2	95.4	556.5
1999	224.3	194.0	88.2	506.5

Sources: Natural Resources Canada; Statistics Canada.

. . Not available; (r) Revised.

(1) Includes nonmetallic mineral mining and all stone quarried, including stone used to make cement and lime. From 1979 onwards, coverage includes miscellaneous nonmetal mines previously excluded.

Note: Numbers may not add to totals due to rounding.

TABLE 37. CANADA, CRUDE MINERALS TRANSPORTED BY CANADIAN RAILWAYS, 1998-2001

	1998 (r)	1999	2000	2001
		(000 tonnes)		
METALLIC MINERALS				
Iron ores and concentrates	38 765	32 263	38 964	30 624
Nickel and nickel-copper ores and concentrates	3 182	2 921	2 351	1 705
Zinc ores and concentrates	1 317	499	1 158	1 127
Copper ores and concentrates	1 189	1 179	1 484	1 717
Lead ores and concentrates	(1)	626	1 030	573
Metallic ores and concentrates, n.e.s.	698	96	99	319
Subtotal	45 151	37 584	45 086	36 065
NONMETALLIC MINERALS				
Potash (KCl)	13 890	13 378	14 197	12 832
Sulphur	6 897	7 570	7 446	6 350
Salt	1 852	1 319	1 218	1 360
Phosphate rock	1 097	94	468	760
Sand, gravel and stone	1 972	2 181	3 026	2 945
Other nonmetallic minerals	5 035	5 870	5 575	5 388
Subtotal	30 742	30 412	31 930	29 635
MINERAL FUELS				
Coal	37 805	42 039	39 253	39 521
Subtotal	37 805	42 039	39 253	39 521
Total crude minerals	113 699	110 034	116 270	105 221
Total revenue freight (2) moved by Canadian railways	279 511	236 674	252 116	239 622
Crude minerals as a percentage of total revenue freight	40.7	46.5	46.1	43.9

Source: Statistics Canada, catalogue no. 52-001-XIE.

n.e.s. Not elsewhere specified; (r) Revised.

(1) Data are included with metallic ores and concentrates, n.e.s. (2) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years this table was calculated using Statistics Canada's annual data series.

As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1998 have been recently recalculated using the monthly data series.

TABLE 38. CANADA, PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1998-2001

	1998	1999	2000	2001
		(000 tonnes)		
METALLIC MINERAL PRODUCTS				
Alumina	4 553	5 174	5 107	5 518
Iron and steel, primary or semi-finished	4 418	2 763	3 650	3 329
Copper, primary cr semi-finished	417	1 137	611	613
Aluminum, primary or semi-finished	1 451	1 528	1 460	1 975
Other nonferrous metals, primary or semi-finished	1 020	413	454	451
Articles of metal-based products	–	1 121	944	742
Metallic waste and scrap	1 563	2 049	2 022	1 978
Total metallic mineral products	13 422	14 186	14 248	14 606
NONMETALLIC MINERAL PRODUCTS				
Sulphuric acid	2 561	2 245	2 384	2 324
Fertilizers (excluding potash)	5 038	4 963	5 041	4 519
Cement	2 084	2 261	2 443	2 430
Other nonmetallic mineral products	2 023	1 040	828	1 149
Total nonmetallic mineral products	11 706	10 509	10 696	10 422
MINERAL FUEL PRODUCTS				
Gasoline and aviation turbine fuel	1 604	1 494	1 539	1 532
Fuel oils and crude petroleum	1 505	3 297	3 357	3 947
Gaseous hydrocarbons, including liquefied petroleum gases	3 814	4 258	4 451	4 451
Coal coke and petroleum coke	1 361	1 253	1 344	1 288
Other refined petroleum and coal products	3 606	1 881	1 994	2 083
Total mineral fuel products	11 890	12 183	12 685	13 301
Total processed mineral products	37 198	36 878	37 629	38 329
Total revenue freight (1) moved by Canadian railways	279 511	236 674	252 116	239 623
Processed mineral products as a percentage of total revenue freight	13.3	15.6	14.9	16.0

Source: Statistics Canada, catalogue no. 52-001-XIE.

– Nil.

(1) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years this table was calculated using Statistics Canada's annual data series.

As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1998 have been recently recalculated using the monthly data series.

TABLE 39. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS TRANSPORTED BY CANADIAN RAILWAYS, 1961-2001

Year	Total Revenue Freight (1)	Total Crude Minerals	Total Processed Mineral Products	Total Crude and Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of Revenue Freight
	(million tonnes)				
1961	138.9	54.1	13.6	67.7	48.7
1962	146.0	60.3	13.8	74.1	50.8
1963	154.6	62.9	15.5	78.4	50.7
1964	180.0	74.6	15.9	90.5	50.3
1965	186.2	80.9	17.3	98.2	52.7
1966	194.5	80.6	17.8	94.4	50.6
1967	190.0	81.2	17.7	98.9	52.1
1968	195.4	86.7	18.8	105.5	54.0
1969	189.0	81.9	27.6	109.5	57.9
1970	211.6	97.5	28.4	125.9	59.5
1971	214.5	95.6	27.4	123.0	57.3
1972	215.8	89.4	27.6	117.0	54.2
1973	241.2	113.1	29.1	142.2	59.0
1974	246.3	115.3	30.9	146.2	59.4
1975	226.0	110.6	26.6	137.2	60.7
1976	238.5	116.6	25.5	142.1	59.6
1977	247.2	121.1	25.7	146.8	59.4
1978	238.8	107.7	26.2	133.9	56.1
1979	257.9	127.2	26.6	153.8	59.6
1980	254.4	124.8	24.6	149.4	58.7
1981	246.6	120.7	26.4	147.1	59.7
1982	212.5	95.7	21.0	116.7	54.9
1983	222.8	95.3	22.7	118.0	53.0
1984	254.6	121.1	25.1	146.2	57.4
1985	250.6	125.2	24.3	149.5	59.7
1986	249.8	121.2	23.0	144.2	57.7
1987	261.4	122.2	22.7	144.9	55.4
1988	269.4	134.9	23.2	158.1	58.7
1989	247.0	122.3	23.1	145.4	58.9
1990	226.3	112.1	20.1	132.2	58.4
1991	233.3	114.4	19.1	133.5	57.2
1992	226.2	102.8	20.9	123.7	54.7
1993	224.0	100.8	21.4	122.2	54.6
1994	253.6	112.6	21.4	134.0	52.9
1995	253.7	118.4	22.0	140.4	55.4
1996	252.1	118.1	21.6	139.7	55.4
1997 (r)	288.9	118.2	31.5	149.7	51.8
1998 (r)	279.5	113.7	37.2	150.9	54.0
1999	236.7	110.0	36.9	146.9	62.1
2000	252.1	116.3	37.6	153.9	61.0
2001	239.6	105.2	38.3	143.5	59.0

Source: Statistics Canada, catalogue no. 52-001-XIE.

(r) Revised.

(1) Revenue freight refers to a local or interline shipment from which earnings accrue to a carrier.

Note: In previous years, this table was calculated using Statistics Canada's annual data series. As of 1999, the annual data series was discontinued; therefore, the monthly data series will be used for this table. Statistics for 1997 and 1998 have been recalculated using the monthly data series.

TABLE 40. CANADA, CRUDE MINERALS LOADED AND UNLOADED IN COASTWISE SHIPPING, 2000

	Loaded							Unloaded				
	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie	Pacific	Total	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie
							(tonnes)					
METALLIC MINERALS												
Iron ore and concentrates	–	–	6 495 696	–	–	–	6 495 696	–	36 612	1 209 566	5 318 985	–
Aluminum ores and concentrates	–	–	20 000	–	–	–	20 000	–	–	–	20 000	–
Other ores and concentrates	–	20 100	3 004 830	–	–	–	3 024 930	–	–	2 999 632	25 298	–
Total metallic minerals	–	20 100	9 520 526	–	–	–	9 540 626	–	36 612 –	4 209 198	5 364 283	–
NONMETALLIC MINERALS												
Salt	–	1 142 994	–	1 515 168	–	153 620	2 811 782	–	399 173	1 132 009	1 126 980	–
Limestone	–	640 237	–	1 876 520	–	1 123 605	3 640 362	–	173 768	466 469	1 876 520	–
Stone, sand and gravel	–	281 348	–	1 887 592	–	1 614 014	3 782 954	–	175 382	277 872	1 715 685	–
Potash	–	–	–	66 423	–	–	–	–	–	15 518	50 905	–
Sulphur	–	–	–	–	–	–	66 423	–	–	–	–	–
Other mineral products (including clays, coal briquettes, greases and asphalt)	–	950 975	73 357	570 875	–	–	1 595 207	–	233 311	801 432	560 464	–
Total nonmetallic minerals	–	3 015 554	73 357	5 916 578	–	2 891 239	11 896 728	–	981 634	2 693 300	5 330 554	–
MINERAL FUELS												
Coal and coke	–	–	–	270 385	–	128 152	398 537	–	–	–	270 385	–
Crude petroleum	–	4 981 532	2 376	1 354	–	–	4 985 262	–	4 831 640	39 821	–	–
Total mineral fuels	–	4 981 532	2 376	271 739	–	128 152	5 383 799	–	4 831 640	39 821	20 385	–
Total crude minerals	–	8 017 186	9 596 259	6 188 317	–	3 019 391	26 821 153	–	5 849 886	6 942 319	10 965 222	–
Total all commodities (1)	801 146	11 565 838	13 222 895	13 223 504	7 804	16 674 509	55 495 696	920 739	9 870 377	13 241 420	14 706 158	9 247
Crude minerals as a percentage of all products		69.3	72.6	46.8		18.1	48.3		59.3	52.4	74.6	

Source: Statistics Canada.
– Nil.
(1) Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded in coastwise shipping.
Note: Numbers may not add to totals due to rounding.

TABLE 41. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED IN COASTWISE SHIPPING, 2000

	Loaded							Unloaded						
	Arctic	Atlantic	St-Lawrence	Great Lakes	Mackenzie	Pacific	Total	Arctic	Atlantic	St. Lawrence	Great Lakes	Mackenzie	Pacific	Total
							(tonnes)							
METALLIC MINERALS PRODUCTS														
Iron, steel and alloys	–	–	1 509	12 491	–	6 520	20 520	–	–	–	14 000	–	6 520	20 520
Other nonferrous metal products	–	–	187 119	–	–	–	187 119	–	–	187 119	–	–		187 119
Other base-metal products	–	111	41 805	–	–	14 300	56 216	–	2 236	39 680	–	–	14 300	56 216
Metallic waste and scrap	–	–	3 344	253 003	–	27 576	283 923		–	28 589	227 758	–	27 576	
Total metallic mineral products	–	111	233 777	265 494	–	48 396	547 778	–	2 236	255 388	241 758	–	48 396	547 778
NONMETALLIC MINERALS PRODUCTS														
Cement and related products	–	–	64 164	390 896	–	31 550	486 610	–	–	3 682	451 378	–	31 550	486 610
Other fabricated nonmetallic minerals, n.e.s.	–	31 004	–		–	–	31 004	–	–	31 004	–	–	–	31 004
Nonmetallic waste and scrap			56 855		–	300 287	357 142	–	–	56 855	–	–	300 287	357 142
Total nonmetallic mineral products	–	31 004	121 019	390 896	–	331 837	874 756	–	–	91 541	451 378	–	331 837	874 756
MINERAL FUEL PRODUCTS														
Gasoline and aviation turbine fuel	756 416	1 275 371	848 789	194 381	1 610	75 378	3 151 945	769 456	1 394 300	528 713	363 703	3 370	75 378	3 134 920
Petroleum coke	–		–	49 885	–	–	49 885	–	–	29 568	20 317	–	–	49 885
Other fabricated mineral fuels, n.e.s.	35 110	1 692 035	1 550 720	1 265 987	6 194	59 423	4 609 469	61 237	1 588 728	1 550 611	1 312 681	5 765	59 423	4 578 465
Total mineral fuel products	791 526	2 967 406	2 399 509	1 510 253	7 804	134 801	7 811 299	830 693	2 983 028	2 108 892	1 696 701	9 155	134 801	7 763 270
Total fabricated mineral products	791 526	2 998 521	2 754 305	2 166 643	7 804	515 034	9 233 833	830 693	2 985 264	2 455 821	2 389 837	9 155	515 034	9 185 804
Total all commodities (1)	801 146	11 565 838	13 222 895	13 223 504	7 804	16 674 509	55 495 696	920 739	9 870 377	13 241 420	14 706 158	9 247	16 665 428	55 413 369
Fabricated minerals as a percentage of all commodities	98.8	25.9	20.8	16.4	100.0	3.1	16.6	90.2	30.2	18.5	16.3	99.0	3.1	16.6

Source: Statistics Canada.

(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.

– Nil.

Note: Numbers may not add to totals due to rounding.

TABLE 42. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN COASTWISE SHIPPING, 1961-2000

Year	Total All Commodities (1)	Total Crude Minerals	Total Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of All Products
		(000 tonnes)		(%)
1961	41 861	9 527	8 857	43.9
1962	39 763	8 361	9 768	45.6
1963	40 328	7 998	9 942	44.5
1964	47 171	8 522	11 194	41.8
1965	48 200	9 183	11 766	43.5
1966	55 122	10 155	12 653	41.4
1967	49 799	11 509	12 207	47.6
1968	50 921	13 698	13 245	52.9
1969	51 890	12 746	14 181	51.9
1970	57 301	14 415	14 818	51.0
1971	55 128	14 783	15 374	54.7
1972	55 326	14 197	15 290	53.3
1973	55 314	16 573	15 615	58.2
1974	53 633	11 723	16 575	52.8
1975	54 373	15 687	17 510	61.1
1976	53 882	15 924	16 208	59.6
1977	58 309	18 131	17 435	61.0
1978	60 668	18 318	16 619	57.6
1979	79 950	22 130	17 486	49.6
1980	82 761	22 947	17 134	48.4
1981	71 271	17 849	16 669	48.4
1982	65 881	16 473	13 214	45.1
1983	67 598	21 248	12 025	49.2
1984	68 698	22 798	11 909	50.5
1985	61 717	19 867	10 291	48.9
1986	60 506	19 901	10 264	49.9
1987	67 572	20 969	11 118	47.5
1988	69 974	23 325	11 676	50.0
1989	62 016	22 963	11 825	56.1
1990	60 360	22 430	16 096	63.8
1991	58 430	19 624	10 370	51.3
1992	52 262	22 125	9 325	60.2
1993	49 976	21 088	8 168	58.5
1994	51 534	21 221	9 510	59.6
1995	50 370	20 626	8 825	58.5
1996	48 829	22 393	7 634	61.5
1997	46 639	20 298	7 461	59.5
1998	47 928	23 358	8 142	65.7
1999	50 791	25 076	7 556	64.2
2000	55 496	26 821	9 234	65.0

Source: Statistics Canada.

(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded in coastwise shipping.

TABLE 43. CANADA, CRUDE MINERALS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,1 1998-2000

	1998		1999		2000	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERALS						
Iron ore and concentrates	30 793 211	7 631 659	28 031 061	7 526 759	29 871 259	7 414 681
Aluminum ores and concentrates	84 099	2 912 687	15 586	2 841 851	–	2 825 699
Lead and zinc ores and concentrates	990 191	560 450	. .	. .	. .	. .
Copper and nickel ores and concentrates	712 123	383 969	474 800	458 345	754 735	641 056
Other metallic ores and concentrates	2 065 168	250 453	2 340 790	922 602	1 059 218	616 231
Metallic waste and scrap	. .	. .	. .	. .	2 132 949	132 743
Total metallic minerals	34 644 792	11 739 218	30 862 237	11 749 557	33 818 161	11 630 410
NONMETALLIC MINERALS						
Limestone	2 843 399	2 979 514	2 807 913	2 932 627	2 619 650	2 769 477
Stone, sand and gravel	857 713	782 724	1 181 787	369 750	7 054 625	777 262
Salt	4 187 659	989 121	3 717 679	1 096 312	3 488 111	852 116
Sulphur	5 231 603	86	5 379 066	309	5 518 670	8 607
Potash	4 764 411	18	4 834 806	6 656	5 118 366	–
Other nonmetallic mineral products	5 895 738	3 112 470	12 986 306	3 273 108	7 928 137	1 612 986
Total nonmetallic minerals	23 780 523	7 863 933	30 907 557	7 678 762	31 727 559	6 020 448
MINERAL FUELS						
Coal and coke	33 682 218	19 443 252	32 312 668	20 561 540	30 757 341	22 728 941
Crude petroleum	9 310 254	27 903 439	9 281 348	28 450 563	12 406 490	29 198 583
Total mineral fuels	42 992 472	47 346 691	41 594 016	49 012 103	43 163 831	51 927 524
Total crude minerals	101 417 787	66 949 842	103 363 810	68 440 422	108 709 551	69 578 382
Total all commodities (1)	178 893 100	100 457 100	179 172 916	101 485 641	187 704 005	105 933 346
Crude minerals as a percentage of all commodities	56.7	66.6	57.7	67.4	57.9	65.7

Source: Statistics Canada.

– Nil; . . Not available.

(1) Includes metallic minerals, nonmetallic minerals and mineral fuels, along with all other cargo loaded and unloaded at Canadian ports.

Note: Numbers may not add to totals due to rounding.

TABLE 44. CANADA, PROCESSED MINERAL PRODUCTS LOADED AND UNLOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE,[1] 1998-2000

	1998		1999		2000	
	Loaded	Unloaded	Loaded	Unloaded	Loaded	Unloaded
			(tonnes)			
METALLIC MINERAL PRODUCTS						
Iron, steel and alloys	1 249 954	5 065 878	145 844	1 079 083	519 265	4 026 614
Nonferrous metals, n.e.s.	1 030 974	4 253 307	885 477	4 112 018	1 099 106	5 844 308
Total metallic mineral products	2 280 928	9 319 185	1 031 321	5 191 101	1 618 371	9 870 922
NONMETALLIC MINERAL PRODUCTS						
Cement and related products	3 453 497	675 398	3 525 229	713 202	3 094 127	633 424
Other nonmetallic minerals, n.e.s.	2 272 853	1 801 768	1 273 210	743 659	1 127 099	876 850
Total nonmetallic mineral products	5 726 350	2 477 166	4 798 439	1 456 861	4 221 226	1 510 274
MINERAL FUEL PRODUCTS						
Gasoline	3 963 390	1 788 736	4 326 864	1 851 140	4 707 087	2 262 669
Fuel oil	3 808 619	3 340 323	3 775 318	2 282 998	5 848 103	2 903 795
Coke, petroleum and coal products	518 117	1 071 176	441 624	1 346 534	685 078	1 742 630
Other mineral fuels, n.e.s.	121 098	676 223	2 895 947	1 613 047	723 043	905 100
Total mineral fuel products	8 411 224	6 876 458	11 439 753	7 093 719	11 963 311	7 814 194
Total processed mineral products	16 418 502	18 672 809	17 269 513	13 741 681	17 802 908	19 195 390
Total all commodities (1)	178 893 100	100 457 100	179 172 916	101 485 641	187 704 005	105 933 346
Processed mineral products as a percentage of all commodities	9.2	18.6	9.6	13.5	9.5	18.1

Source: Statistics Canada.
n.e.s. Not elsewhere specified.
(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.
Note: Numbers may not add to totals due to rounding.

TABLE 45. CANADA, CRUDE MINERALS AND PROCESSED MINERAL PRODUCTS LOADED AT CANADIAN PORTS IN INTERNATIONAL SHIPPING TRADE, 1961-2000

Year	Total All Commodities (1)	Total Crude Minerals	Total Processed Minerals	Crude Minerals and Processed Mineral Products as a Percentage of All Products
		(000 tonnes)		
1961	48 771	23 241	2 133	52.0
1962	54 676	30 446	2 296	59.9
1963	62 031	32 214	2 503	56.0
1964	75 760	42 087	2 602	59.0
1965	74 521	41 338	2 746	59.2
1966	76 192	41 374	3 350	58.7
1967	72 598	42 704	3 701	63.9
1968	78 663	48 680	2 960	65.6
1969	70 432	42 442	3 456	65.2
1970	95 807	55 849	4 965	63.5
1971	95 887	53 245	5 022	60.8
1972	98 988	51 912	9 091	61.6
1973	112 434	64 195	10 103	66.1
1974	106 110	64 093	9 041	68.9
1975	102 444	61 970	7 495	67.8
1976	114 815	71 527	6 108	67.6
1977	119 770	70 257	5 979	63.7
1978	116 522	62 291	7 556	59.9
1979	134 639	79 685	8 901	65.8
1980	138 161	67 898	11 770	57.7
1981	145 445	83 007	9 022	63.3
1982	125 282	65 594	7 115	58.0
1983	129 490	67 152	6 197	56.6
1984	145 322	82 752	7 986	62.4
1985	143 421	83 878	10 814	66.0
1986	144 561	84 720	8 303	64.3
1987	158 994	86 085	10 488	60.7
1988	171 064	98 934	12 227	65.0
1989	159 069	90 807	13 624	65.7
1990	159 039	88 504	15 107	65.1
1991	168 030	90 165	16 138	63.3
1992	153 786	78 600	14 643	60.6
1993	152 162	81 418	16 723	64.5
1994	169 463	94 423	15 725	65.0
1995	176 540	100 103	16 346	66.0
1996	174 306	96 952	18 580	66.3
1997	187 717	110 983	18 467	69.0
1998	178 893	107 719	16 419	69.4
1999	179 173	103 364	17 269	67.3
2000	187 704	108 709	17 803	67.4

Source: Statistics Canada.

(1) Includes metallic mineral products, nonmetallic mineral products and mineral fuel products, along with all other cargo loaded and unloaded at Canadian ports.

TABLE 46. CANADA, CAPITAL AND REPAIR EXPENDITURES BY SELECTED INDUSTRIAL SECTOR, 2000-02

($ millions)

		Capital Expenditures			Repair Expenditures		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
Agriculture, forestry, fishing and hunting	2000	1 586.2	2 607.6	4 193.8	752.1	2 594.6	3 346.7
	2001 (p)	1 544.5	2 600.6	4 145.1	. .	. .	. .
	2002 (i)	1 585.3	2 657.8	4 243.1	. .	. .	. .
Mining (1)	2000	21 264.9	3 512.7	24 777.6	695.3	2 099.1	2 794.4
	2001 (p)	23 539.6	5 470.9	29 010.5	. .	. .	. .
	2002 (i)	19 083.8	5 540.4	24 624.2	. .	. .	. .
Manufacturing	2000	4 410.8	17 673.5	22 084.3	1 271.1	8 918.0	10 189.1
	2001 (p)	3 003.7	15 090.1	18 093.8	. .	. .	. .
	2002 (i)	2 892.7	15 013.7	17 906.4	. .	. .	. .
Construction	2000	332.0	2 467.9	2 799.9	64.5	1 061.4	1 125.9
	2001 (p)	351.7	2 596.6	2 948.3	. .	. .	. .
	2002 (i)	360.7	2 655.0	3 015.7	. .	. .	. .
Transportation and warehousing	2000	5 164.0	5 572.8	10 736.8	1 318.5	4 099.1	5 417.6
	2001 (p)	4 648.6	6 471.4	11 120.0	. .	. .	. .
	2002 (i)	4 488.2	5 639.7	10 127.8	. .	. .	. .
Utilities	2000	4 971.2	3 108.4	8 079.6	1 143.2	1 013.3	2 156.5
	2001 (p)	5 736.2	3 386.0	9 122.2	. .	. .	. .
	2002 (i)	6 416.6	4 340.3	10 756.9	. .	. .	. .
Wholesale and retail trade	2000	2 635.5	6 021.0	8 656.5	523.1	839.3	1 362.4
	2001 (p)	2 636.5	6 123.0	8 759.5	. .	. .	. .
	2002 (i)	2 841.7	6 192.8	9 034.5	. .	. .	. .
Housing	2000	40 845.3	–	40 845.3	5 709.7	0.0	5 709.7
	2001 (p)	43 073.5	–	43 073.5	. .	. .	. .
	2002 (i)	43 626.1	–	43 626.1	. .	. .	. .
Total (2)	2000	104 937.2	82 420.9	187 358.1	17 124.7	24 747.4	41 872.1
	2001 (p)	111 870.0	83 984.8	195 854.8	. .	. .	. .
	2002 (i)	109 006.2	84 971.6	193 977.8	. .	. .	. .
Mining as a percentage of total	2000	20.3	4.3	13.2	4.1	8.5	6.7
	2001 (p)	21.0	6.5	14.8	. .	. .	. .
	2002 (i)	17.5	6.5	12.7	. .	. .	. .

Source: Statistics Canada.

– Nil; . . Not available; (i) Intentions; (p) Preliminary actual.

(1) Includes mines, quarries and oil wells. (2) Includes finance, real estate, insurance, commercial services, institutions and government departments.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System (NAICS).

TABLE 47. CANADA, CAPITAL AND REPAIR EXPENDITURES IN THE MINERAL INDUSTRY (1) BY PROVINCE AND TERRITORY, 2000-02

Province/ Territory		Capital Expenditures			Repair Expenditures		
		Construction	Machinery and Equipment	Total	Construction	Machinery and Equipment	Total
				($ millions)			
Newfoundland and Labrador	2000	x	x	1 232.1	x	x	x
	2001 (p)	x	x	1 100.7	. .	. .	. .
	2002 (i)	x	x	946.9	. .	. .	. .
Prince Edward Island	2000	0.1	x	x	x	x	0.1
	2001 (p)	5.0	x	x	. .	. .	. .
	2002 (i)	3.2	x	x	. .	. .	. .
Nova Scotia	2000	640.4	57.0	697.4	2.1	49.9	52
	2001 (p)	631.9	42.9	674.8	. .	. .	. .
	2002 (i)	745.4	80.1	825.5	. .	. .	. .
New Brunswick	2000	89.6	42.7	132.3	x	23.5	x
	2001 (p)	74.1	31.5	105.6	. .	. .	. .
	2002 (i)	74.7	22.9	97.6	. .	. .	. .
Quebec	2000	943.5	247.4	1 190.9	28.2	331.0	359.3
	2001 (p)	652.1	167.1	819.2	. .	. .	. .
	2002 (i)	417.5	122.9	540.4	. .	. .	. .
Ontario	2000	567.4	257.4	824.8	49.6	297.4	347.0
	2001 (p)	522.5	268.5	791.0	. .	. .	. .
	2002 (i)	412.1	237.5	649.6	. .	. .	. .
Manitoba	2000	206.3	29.7	236.0	6.1	45.7	51.8
	2001 (p)	214.9	19.6	234.5	. .	. .	. .
	2002 (i)	206.8	56.9	263.7	. .	. .	. .
Saskatchewan	2000	1 848.4	142.9	1 991.3	67.0	159.9	226.9
	2001 (p)	1 615.3	157.1	1 772.4	. .	. .	. .
	2002 (i)	1 397.1	186.9	1 584.0	. .	. .	. .
Alberta	2000	13 493.3	2 538.4	16 031.7	411.8	758.3	1 170.1
	2001 (p)	15 361.6	4 394.1	19 755.7	. .	. .	. .
	2002 (i)	12 286.2	4 524.2	16 810.4	. .	. .	. .
British Columbia	2000	1 613.8	135.2	1 749.0	97.2	261.5	358.7
	2001 (p)	2 234.4	226.0	2 460.4	. .	. .	. .
	2002 (i)	1 717.8	162.8	1 880.6	. .	. .	. .
Yukon	2000	17.4	0.4	17.8	x	x	3.1
	2001 (p)	17.0	0.9	17.9	. .	. .	. .
	2002 (i)	18.5	5.7	24.2	. .	. .	. .
Northwest Territories	2000	565.2	41.1	606.3	5.8	55.0	60.8
	2001 (p)	1 140.1	60.3	1 200.4	. .	. .	. .
	2002 (i)	890.7	50.6	941.3	. .	. .	. .
Total Canada	2000	21 264.9	3 512.7	24 777.6	695.3	2 099.1	2 794.4
	2001 (p)	23 539.6	5 470.9	29 010.5	. .	. .	. .
	2002 (i)	19 083.8	5 540.4	24 624.2	. .	. .	. .

Source: Statistics Canada.

. . Not available; (i) Intentions; (p) Preliminary actual; x Confidential.

(1) Includes mines, quarries and oil wells.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System (NAICS).

TABLE 48. CANADA, CAPITAL AND REPAIR[1] EXPENDITURES IN THE MINING AND OIL AND GAS EXTRACTION INDUSTRIES, 2000-02

	2000			2001 (p)	2002 (i)
	Capital	Repair	Total	Capital	Capital
			($ millions)		
MINING					
Metal ore mining					
Iron	254.3	175.6	429.9	303.2	147.50
Gold and silver	564.6	259.0	823.6	353.9	325.80
Lead-zinc	x	x	x	x	48.10
Nickel-copper	293.5	169.6	463.1	275.2	x
Copper-zinc	252.4	171.9	424.3	261.8	204.00
Uranium	x	x	x	x	x
Other metal mines	442.2	40.1	482.3	305.9	108.70
Total	2 142.7	964.5	3 107.2	1 670.8	1 251.70
Nonmetallic mineral mining and quarrying					
Stone	98.9	41.1	140.0	45.0	39.60
Sand and gravel, clay, and ceramic and refractory materials	50.3	30.3	80.6	52.5	37.40
Asbestos	x	x	x	x	x
Gypsum	34.3	16.9	51.2	18.5	40.90
Potash	120.8	79.1	199.9	142.6	129.90
Peat	x	x	x	x	x
Other nonmetal mines	349.4	125.1	474.5	668.6	501.20
Total	751.4	323.8	1 075.2	995.8	820.50
Coal	115.1	187.6	302.7	159.3	242.40
Oil and gas extraction	20 767.5	1 007.2	21 774.7	25 006.7	21 515.50
Support activities for mining and oil and gas extraction	1 000.8	311.4	1 312.2	1 177.8	793.90
Total mineral industry	24 777.5	2 794.5	27 572.0	29 010.4	24 624.00

Source: Statistics Canada.

(i) Intentions; (p) Preliminary actual; x Confidential.

(1) Includes mines, quarries and oil wells. (2) Includes finance, real estate, insurance, wommercial services, institutions and government departments.

Notes: Numbers may not add to totals due to rounding. Capital and repair expenditures are based on the North American Industry Classification System (NAICS).

Definitions and Valuation: Mineral Production, Shipments and Trade

MINERAL STATISTICS

The publication of statistics on the mineral production of Canada was instituted by the Geological and Natural History Survey of Canada as early as 1886. The Department of Mines carried out this compilation through the early part of the twentieth century. Subsequently, the work was transferred to Statistics Canada, which published the data for the period 1921 to 1978. In January 1979, the responsibility for Canadian non-fuel mineral statistics was transferred from Statistics Canada to the Department of Energy, Mines and Resources (now Natural Resources Canada). Statistics Canada retains responsibility for fuels and mineral manufacturing statistics (including cement, lime, clay, and smelting and refining).

The construction of new metallurgical plants and the development of new types of ore have resulted in changes in methods of compilation over the period but, in general, the following principles have been followed.

For nonmetallic minerals such as asbestos, talc, barite, etc., and for structural materials such as stone, cement, etc., the mine or quarry shipments are taken to represent production. Usually there is little difference between actual output and mine shipments, and it is more convenient and practical to measure the product at the latter point. Values are computed on the f.o.b. shipping point basis and they represent, therefore, the amounts actually received by the producers. Values are adjusted to exclude the costs of containers, taxes, duties, sales discounts and outward-bound transportation.

Production data for certain simple metallic ores such as iron ore, uranium, etc., are compiled in a similar manner, that is, products shipped from a specific shipping point at f.o.b. values. For some metals this is not practical and an attempt is made to measure output in terms of recoverable metals in concentrates shipped, which are then valued at current market prices.

The value of metallic mineral production calculated in this manner does not coincide with the amounts actually received by the producers.

DETAILS OF THE METHODS USED IN COMPUTING THE MINERAL PRODUCTION OF CANADA

Metallic Mineral Production

Antimony

Production includes recoverable antimony in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Bismuth

Production includes recoverable bismuth in concentrates shipped. The value is calculated using the yearly average New York dealer price.

Cadmium

Cadmium is associated with zinc. Production includes the recoverable content of cadmium in the zinc-lead concentrates shipped, valued at the yearly average New York dealer price.

Calcium

Output figures represent calcium metal plus the calcium content of alloys from Canadian sources valued at the average yearly price of metal crowns.

Cesium

Production figures represent the cesium oxide content of pollucite ore shipped. The value is as reported by the producer.

Cobalt

Production includes recoverable cobalt in concentrates shipped. The value is calculated using the average yearly cathode dealer spot prices.

Copper

Production includes recoverable copper in concentrates shipped. The value is calculated using a combination of the Commodities Exchange, Inc. (COMEX) first position price and the average London Metal Exchange Grade A Settlement price.

Germanium

Production includes germanium contained in concentrates shipped with values as reported by the shipper.

Gold

Production includes gold in crude bullion obtained directly from placer workings and lode gold mines, and recoverable gold in all types of ores and concentrates shipped. The value is calculated using the average final price as established by bullion dealers in London.

Ilmenite

Production includes shipments of direct shipping grade ore at Canada's sole shipper's reported value.

Indium

Production includes quantities recovered in the smelting of silver-lead-zinc ores from Canadian sources. The output is valued by the shipper.

Iron Ore

Production figures represent product shipments (pellets, concentrates, ores) at the values shown by the shippers. Production from steel plant waste oxides is excluded.

Iron (Remelt)

This is sometimes called pig iron or Sorel iron. It is a co-product in the smelting of ilmenite ores. Quantity and value figures are those reported by the producer.

Lead

Production includes recoverable lead in concentrates shipped. The value is computed at the average producer price for the year.

Lithium

Production figures represent the lithium oxide content of spodumene and amblygonite ore shipped. The value is as reported by the producer.

Magnesium

Output figures represent magnesium metal, plus the magnesium content of alloys from Canadian sources. Values are compiled using the average yearly price of primary ingots.

Molybdenum

Production figures are the molybdenum content of the oxides, ferromolybdenum and sulphides shipped; the value is that shown by the shipper.

Nickel

Production includes recoverable nickel in concentrates shipped. The value is calculated using an assessment price based on London Metal Exchange prices.

Niobium (Columbium)

Production includes niobium (columbium) contained in concentrates shipped with values as reported by the shipper.

Platinum Group Metals (PGM)

Production figures for iridium, palladium, platinum, ruthenium and rhodium include recoverable metal in concentrates shipped. Quantities are valued using average New York dealer prices or London Metal Exchange prices, depending on the metal.

Rhenium

Production figures reflect the content of concentrates shipped. Values are those reported by the shipper.

Rubidium

Production figures include the content of concentrates shipped. Values are as reported by the shipper.

Selenium

Production includes selenium produced as a refinery by-product from Canadian sources and recoverable selenium contained in concentrates exported. The quantities are valued at the average New York dealer price for the year.

Silver

Production includes silver in crude bullion obtained directly from placer workings and lode gold mines, and recoverable silver in all types of ores and concentrates shipped. The value is calculated using the average of Toronto quotations for the year.

Tantalum

Production comprises the tantalum pentoxide content of concentrates shipped as valued by the shipper.

Tellurium

Production includes tellurium produced as a refinery by-product from Canadian sources and recoverable tellurium contained in concentrates exported. The quantities are valued at the average producers' price for the year.

Uranium

Producers of uranium precipitates or concentrates report the metal content (U) of the shipments and the value is calculated by Natural Resources Canada.

Zinc

Production comprises recoverable zinc in concentrates shipped. The value is calculated using the average London Metal Exchange price for the year.

Nonmetallic Mineral Production

Owing to the fact that it is difficult to obtain figures of the actual production of nonmetallic minerals in Canada, and since the first actual measurement is when the product is sold, plant shipments have been taken to represent production in all cases.

Barite

Production is the shipments of the various grades at the selling value, f.o.b. shipping points.

Cement

Production comprises shipments of Portland and masonry cements, exported clinker, and transfers to other corporate divisions for use in other manufacturing processes. Values are f.o.b. plant, as reported by the shipper.

Chrysotile (Asbestos)

Production figures represent shipments of the various grades at the total selling value, f.o.b. shipping points, less the value of containers.

Clay Products

Production represents shipments of brick and other clay products made from domestic clays, and shipments of unmanufactured clays (bentonite, diatomite) at the total selling value, f.o.b. works, as reported by the operators. Data relating to clay products manufactured from imported clays are not included.

Diamonds

Production is shipments from the mine. The value is calculated by Natural Resources Canada.

Gemstones

Production is the tonnage of crude and rough cut amethyst, jade and labradorite shipped at its selling value, f.o.b. shipping points.

Graphite

Production is the shipments of various grades from the mill at its selling value, f.o.b. the mill, less container costs.

Gypsum[1]

Production is taken as the tonnage of crude gypsum and anhydrite shipped from quarries or mines in lump, crushed or fine-ground forms. The value is that reported by the operators. (Note: Gypsum used in the manufacture of cement in Canadian cement plants is excluded.)

Lime

Production represents the tonnage of hydrated and quicklime shipped (sold by the producer) together with the tonnage of these limes produced and used by the producers of chemicals and allied products. The values are as reported by the producer.

Magnesitic Dolomite (Magnesite)

Production is the tonnage of crude material sold by primary producers, plus the tonnage of calcined or dead-burned material sold or used by primary producers. The value is that reported by the producers.

Marl

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Mica

Production is recorded as shipments from plants dressing new mica, and exported shipments directly from the mines. The value of shipments is taken as reported by operators.

Nepheline Syenite

Production of crude and ground nepheline syenite is the amount of the various grades shipped at the total selling value, f.o.b. works, less container costs.

Peat

Production comprises crude peat shipped to Canadian non-producers as fuel or for export, baled peat shipped, and the peat content of mixed products shipped. Value is the sales value, f.o.b. works, less the cost of containers.

Phosphate

Production is shipments from the plant. Values are f.o.b. plant as reported by the producer.

Potash

Production represents producers' shipments of various grades from the plant and is measured as the K_2O equivalent. The value of shipments, f.o.b. plant, is reported by the producers.

Potassium Sulphate

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Pumice

Production is producers' shipments from the plant. Values, f.o.b. plant, are reported by the producer.

Quartz (Silica)[1]

Production represents the tonnage of crude or pulverized quartz, quartzite, pure silica sand, or other natural silica material shipped for sale, plus the tonnage of any of these materials used by producers. The value is taken as reported by producers.

Salt

Production is taken as the tonnage of various grades of dry salt shipped by primary producers, plus the salt content of brine used by producers for industrial (chemical) purposes. The value is that reported by producers.

Sand and Gravel[1]

Production represents shipments of natural gravel, sand and crushed gravel at the values reported by operators of sand and gravel pits or dredges.

Serpentine

Production represents producers' shipments of various grades valued f.o.b. plant, as reported by the producer.

Soapstone, Talc, Pyrophyllite

Production comprises crude, ground or sawn soapstone shipments; crude, milled or refined talc shipments; and crude or ground pyrophyllite shipments. All shipments are f.o.b. the mill or plant and are valued by the shipper.

Sodium Sulphate

Production is the tonnage of crude or refined natural sodium sulphate shipped at its selling value, f.o.b. shipping points. The figures exclude the sodium sulphate produced as a by-product of paper or rayon manufacturing.

Stone[1]

Production represents quarry shipments of crude or undressed stone, crushed stone and dressed stone, if the latter is prepared by the quarry operators at values as reported by the operators. The figures include data for both private and public or municipally owned properties. Production figures do not include dressed stone prepared from imported stone or prepared from domestic stone in works not at the quarries.

Sulphur in Smelter Gas

Prior to final metal recovery, sulphide concentrates are smelted or roasted and the resultant gases may be used to produce marketable sulphur, sulphur dioxide or sulphuric acid. Production is considered as the sulphur content of sulphuric acid made, sulphur dioxide marketed and sulphur shipped. This sulphur is valued at the average price for sulphur sold in acid. Production is shown by province/territory of origin of concentrates.

Sulphur, Elemental

In the western provinces, sour natural gas is processed to remove hydrogen sulphide, which is further reduced to yellow elemental sulphur. Sulphur recovered from the refining of Canadian crude petroleum is also included. Production is shown by province of origin of material and values are as reported by the shippers.

Titanium Dioxide

Ilmenite ore is smelted at Sorel, Quebec, to produce a slag containing titanium dioxide. Production is the titanium dioxide content of slag valued by the producer.

Tremolite

Production is shipments of various grades at the selling values, f.o.b. shipping point, less the value of containers.

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[1] To avoid duplication in computing a total value for Canadian mineral production, the quantity and value of gypsum, silica, stone,and sand and gravel used in the manufacture of lime, cement and clay products are not included in the totals for gypsum, silica, stone, and sand and gravel production. These particular data are recorded separately and are published in conjunction with data for the lime, cement and clay industries.

Wollastonite

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Zeolite

Production is shipments from the plant. Values are f.o.b. plant, as reported by the producer.

Fuels

Coal

Production figures are equal to shipments from the mine/plant plus "own" consumption as valued by shippers, f.o.b. mine/plant.

Natural Gas

Production figures represent sales of natural gas from dry gas fields after field uses, losses and reinjection, but before inventory changes. Values are as reported by the producers.

Natural Gas By-Products

Production figures for propanes, butanes, etc., represent the quantity that is available for market. It is the quantity produced by gas processing plants after processing and reprocessing plant uses, losses and shrinkage. Values are selling value, f.o.b. shipping points.

Oil, Crude and Equivalent

Production figures represent the production of crude oil from both conventional and non-conventional sources after field use, losses and reinjection. Values are those reported by shippers, f.o.b. well head or plant.

VALUATION OF TRADE DATA

(Note: The following has been extracted from Statistics Canada catalogue no. 65-003.)

For Customs purposes, imports are recorded at values established according to the provisions of the *Customs Act* which, since January 1, 1985, reflects valuation methods based on the General Agreement on Tariffs and Trade (GATT) Valuation Code System. It generally requires that the value for duty of imported goods be equivalent to the transaction value or the price actually paid.

To determine the transaction value of imported goods, all transportation and associated costs arising in respect of the goods being appraised prior to and at the place of direct shipment to Canada are to be added to the price of the goods. Therefore, Canadian imports are valued f.o.b. (free on board), place of direct shipment to Canada. The value excludes freight and insurance costs in bringing the goods to Canada from the point of direct shipment.

To countries other than the United States, exports are, in principle, valued or recorded at the values declared on export documents, which usually reflect the transaction value, i.e., actual selling price, or in the case of a non-arm's-length transaction, the transfer price used for company accounting purposes. Canadian exports to overseas countries are valued at f.o.b. port of exit, including domestic freight charges to that point, but net of discounts and allowances. As of January 1990, Canadian exports to the United States are valued f.o.b. point of exit from Canada. Prior to 1990, they were valued f.o.b. place of lading net of freight charges, discounts and allowances.